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Are Comparable Worth Systems Truly Comparable?

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Study of
American Business
Washington University · St. Louis

This booklet is one in a series designed to enhance the understanding of the private enterprise system and the key forces affecting it. The series provides a forum for considering vital current issues in public policy and for communicating these views to a wide audience in the business, government, and academic communities. Publications include papers and speeches, conference proceedings, and other research results of the Center for the Study of American Business.

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Introduction

The free-market system for determining wages is under attack. Despite existing sex-discrimination laws that mandate equal pay for equal work, critics say full-time working women receive about 60 cents for every dollar earned by men. As a result, almost every state has considered studying or adopting some form of comparable worth, the concept of equal pay for dissimilar jobs of "comparable worth."

The government-administered comparable worth systems would be more objective than current subjective job evaluation systems, comparable worth advocates say. The general partner of a firm that has developed and implemented comparable worth plans says "job evaluation is, at its best, a disciplined, objective process for rank-ordering jobs on an agreed compensable value scale."[1]

A business representative for the International Federation of Professional and Technical Engineers, Local 17, in Washington State agrees. "My opponents have no cause to portray pay equity advocates as coming after the whole economic structure with bulldozers when in fact we are using more precise instruments to change only one specific feature of the economy."[2] A comparable worth system is deemed to be more accurate because it determines the values of different job aspects through numerical scores. Indeed, a Virginia study reports that other "state officials perceived quantitative systems as being more accurate and consistent than their old systems."[3]

This report analyzes a neglected question in the comparable worth debate: Does the idea in practice live up to the promises of its proponents? This report seeks to answer this question by examining systems that have been considered or developed at the state level to determine how objective and consistent they really are.

The first section of the study compares the relative importance accorded various job classes for those states that have taken the comparable worth process this far. The next section describes the process that produces these job evaluations, highlighting some reasons that individual states give for making particular choices under the comparable worth approach. The last section summarizes the report's findings.

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Comparing the Results of State Comparable Worth Studies

One of the chief arguments of comparable worth proponents is that this method for evaluating job classes and ultimately setting pay scales is more "objective" and "consistent" than market-oriented systems. If this argument is valid, it is reasonable to expect consistent rankings of job classes among the individual states using this approach.

But glaring inconsistencies result across the states. The greatest amount of information on the results obtained from comparable worth studies are available from the states of Iowa, Minnesota and Vermont. A fourth state, Washington, is included briefly in this section because fewer job evaluation results are available for this state than for the other three (six categories compared with 14). Iowa and Minnesota actually have implemented comparable worth systems for their state workers. Washington will soon follow suit as a result of its recently settled court case. Vermont is studying a proposed plan developed by the same consulting firm that fashioned Washington's system.

Because each state has a unique comparable worth point system, the numbers need to be put on a common base in order to compare job evaluations from state to state. For the purposes of the report, the lowest-rated job in each state was given a base value of 100. An index was then calculated for all other jobs based on the ratio of points for those jobs to the points assigned for the lowest-rated job.

For example, the lowest-rated job in the Vermont study was the entry-level secretary worth 84 points. For this comparison, the secretary's score was given the index value of 100. Then the next job, data entry operator, whose raw points totalled 92, was assigned a score of 110 ([92 divided by 84] x 100).

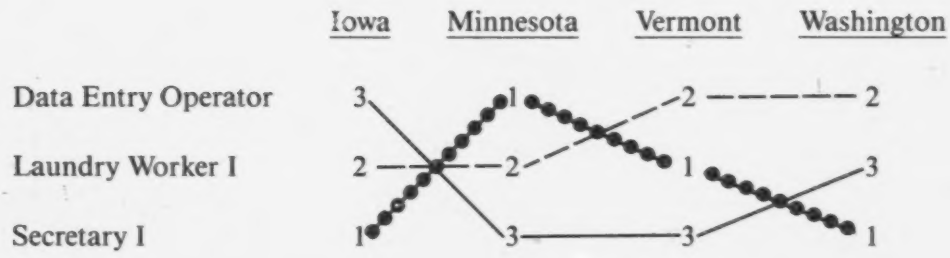
The index values allow comparisons and rankings of jobs across states, such as the rankings of the three jobs shown in Table 1. This table displays how the rankings among three job classes—entry-level secretaries, laundry workers and data entry operators—differ for Iowa, Minnesota, Vermont and Washington State. A secretary would be ranked first among these three jobs in Washington State and Iowa, but third in Minnesota and Vermont. A data entry operator would place first in Minnesota but third in Iowa, while Vermont and Washington would rank the job second among the three job classes.

The lines drawn in Table 1 indicate the crossover of rankings from state to state. In the case of neighboring Iowa and Minnesota, the "crossover" eventually may translate into actual migration of secretaries and data entry operators because their "worth" varies considerably on either side of the state line.

Perhaps the easiest way to see just how different these evaluations of job categories are by state is to graph their indexed values as is shown in Figure 1. For example, a photographer is valued more than twice as highly in the Vermont

Table 1

JOB RANKINGS VARY ACROSS STATES[1]



[1]Rankings are from 1 to 3, with 1 being the highest rated of the three jobs and 3 the job of least value among the three.

Source: Center for the Study of American Business, Washington University in St. Louis. Information derived from studies referenced in Table 2 and the Washington State Study, *Public Personnel Management Journal*, Winter 1981/82, p. 378.

study as in Iowa, whereas a photographer in Minnesota is worth 25 percent more than the one in Iowa.

In another instance, inconsistencies afflict the values of librarians. A Minnesota librarian is worth 30 percent more than a Vermont librarian, who in turn is 20 percent more valuable than one in Iowa.

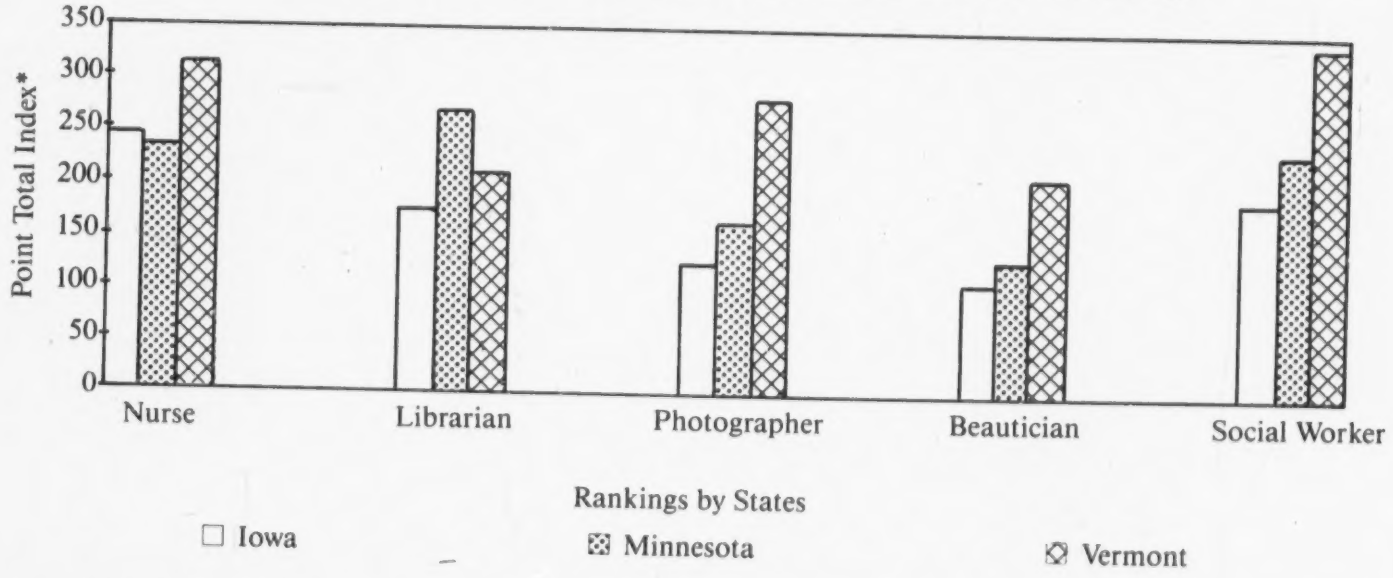
Comparable worth evaluations of jobs are anything but "comparable" in practice.

Many other discrepancies occur in the job scores for the three states where 14 job classes were evaluated (see Table 2). Take a registered nurse, a chemist and a social worker, for example. In Minnesota, the three jobs have equal values. However, Iowa's study finds the nurse worth 29 percent more than the social worker, who in turn is worth 11 percent more than the chemist. While the chemist also receives the lowest point score of the three positions in the Vermont study, the social worker and nurse reverse rankings. The social worker is valued about 10 percent more than the nurse, who is worth 10 percent more than the chemist.

In short, comparable worth evaluations of jobs are anything but "comparable" in practice. The "worth" ascribed to comparable jobs in the different states is not consistent. As a result, any unbiased party surely must question whether comparable worth truly can deliver on its promise of a scientific, objective determination of a job's worth.

Figure 1

HOW STATE JOB EVALUATIONS STACK UP AGAINST ONE ANOTHER



*Index values for each state are calculated by assigning a base value of 100 to the job with the lowest point score, ratioing raw point scores to the base score and multiplying by 100.

Source: Center for the Study of American Business, Washington University in St. Louis. Derived from sources listed in Table 2.

Table 2
COMPARISON OF JOB CATEGORIES BY STATES

	IOWA			MINNESOTA			VERMONT*		
RANKINGS	JOB	ORIGINAL POINTS	INDEX	JOB	ORIGINAL POINTS	INDEX	JOB	ORIGINAL POINTS	INDEX
1	Nurse	(382)	248	Librarian	(275)	275	Social Worker A	(287)	342
2	Social Worker I	(295)	192	Chemist	(238)	238	Nurse-General Duty	(262)	312
3	Librarian I	(273)	177	Social Worker	(238)	238	Chemist A	(238)	283
4	Chemist I	(266)	173	Registered Nurse	(238)	238	Photographer	(238)	283
5	Revenue Examiner I	(254)	165	Dental Hygienist	(209)	209	Dental Hygienist	(196)	233
6	Dental Hygienist	(252)	164	Tax Examiner	(194)	194	Librarian A	(178)	212
7	Secretary I	(217)	141	Photographer	(167)	167	Beautician	(178)	212
8	Photographer	(205)	133	Baker	(147)	147	Tax Examiner A	(178)	212
9	Laundry Worker I	(193)	125	Beauty Operator	(142)	142	Baker	(122)	145
10	Cook I	(188)	122	Cook	(129)	129	Cook A	(111)	132
11	Baker I	(188)	122	Janitor	(111)	111	Janitor [Building Custodian A]	(101)	120
12	Beautician	(187)	121	Data Entry Operator	(106)	106	Laundry Worker	(101)	120
13	Data Entry Operator	(174)	113	Laundry Worker	(105)	105	Data Entry Operator	(92)	110
14	Janitor	(154)	100	Secretary [Clerk-Typist]	(100)	100	Secretary A	(84)	100

Numbers in parentheses indicate original point totals. Other numbers are indicies based on a value of the job class with the lowest point total.

*A range of points was given for each Vermont job. The scores in this table are midpoints of these ranges.

Source: Center for the Study of American Business, Washington University in St. Louis.
Derived from "Hay Point Ratings for State of Minnesota Jobs by Pts.," October 1985;
Norman D. Willis and Associates, Inc., "State of Vermont Classification and Compensation Study," December 1985;
and Arthur Young and Company, "Study to Establish an Evaluation System for State of Iowa Merit Employment System Classifications on the Basis of Comparable Worth," April 1984.

Phases of Comparable Worth Studies

The source of the inconsistencies shown above is found in the decisions made throughout the comparable worth process. An arbitrary decision in one phase often is compounded by several such decisions in other phases.

In this section, the process is examined across several states—New Jersey, Minnesota, Iowa, Kansas, Michigan, New York, Oregon, Washington and Vermont. This group of states differs from the one in the comparison of state studies section because more states have studied the process yet have not published actual job point totals. All of these states cannot be compared in every phase because some of them studied just certain parts of the comparable worth process. In some cases, insufficient information was available. In other cases such as in Michigan and New York, the purposes of the studies were different than those of other states, but they still developed information for some of the same phases that the other states did.

Although comparable worth studies are as diverse as they are inconsistent, the studies analyzed in this report tend to follow a common format. First, a comparable worth study attempts to define comparable worth. Second, it determines what percentage of men or women in a job class constitutes a male-dominated or female-dominated class.

After gender-dominated classes are selected, they are compared to see if a wage gap exists. If a gap is shown to exist, it is sufficient justification for a more comprehensive study or a comparable worth system proposal.

With the need for reform established, a group of evaluators is chosen. The evaluation team usually consists of state employees who are supposed to be representative of the state work force in such attributes as sex, race and occupational group.

Next, the evaluation process begins. Information is collected to form job descriptions. The jobs are grouped into classes, with classes containing few members often merged into larger ones.

When the grouping is completed, a set of job factors is selected. Factors are job characteristics such as experience and working conditions that determine how much a job is "worth." A set of factors is either created by the state evaluators or adopted from a standardized set developed by a management consulting firm. Many states use a system created by Hay Associates.

Evaluators next weight the relative importance of each factor by assigning a percentage figure to it, sometimes altering the consulting firm's recommendations. For example, knowledge may be weighted at 20 percent while working conditions may be weighted at 5 percent. The weighting for all factors must total 100 percent.

After weighting these job characteristics, evaluators divide each factor into levels or degrees of difficulty. For instance, the lowest level of the knowledge factor may involve simple, practical procedures, while the highest level may require professional mastery of specialized or scientific techniques.

The number of levels for each factor may differ. Levels are assigned numbers, with the number for each level increasing as the difficulty increases; for example, the lowest level may be worth three points, while the highest level may be worth 25 points. The percentage increase in points between each level is constant in an attempt to ensure consistency.

With the numbers created, evaluators start assigning points for each job. They individually evaluate each job by the factors to determine the number of points. When totals are compared for the individual evaluators, they may not agree. If so, the point scores are either averaged or the evaluators discuss the matter until they reach a consensus.

If a consulting firm's system is used, the consultants may override or modify an evaluator's decision in the name of "quality control" or "consistency." For example, the consultants may challenge an evaluation that seems unusual. They will ask the evaluator to justify his or her judgment by referring to interview notes or questionnaires. If the consultants believe the evaluation is inconsistent with how the system is supposed to work, they will overrule the evaluation.

After the points are decided, job classifications are assigned to specific pay ranges or salary levels used by the state government. A range of point totals is assigned to a given pay category. For instance, jobs "worth" 87-105 points may be assigned range 1; 106-125 points may be needed to receive range 2 status and so on. Any given job classification is assigned to a pay grade according to the points accumulated. The higher the points, the higher the grade assigned. The percentage increase in points between each pay range is constant to promote consistency.

While these various steps sound cut and dried, a variety of subjective decisions are actually required in each phase. The remainder of this section examines the diverse approaches used by individual states in conducting a comparable worth study.

Defining Gender-dominated Classes

Determining what constitutes a male- or female-dominated class is important because it often decides which job classes will be examined in comparable worth studies. Most states try to keep the standard simple. The commonly used criterion is that a male-dominated class contains 70 percent or more male workers, while a female-dominated class has 70 percent or more female employees.

This definition, however, is not followed universally. As a Kansas study observes, female- or male-dominated classes with few members can distort the distribution of job classes.[4] After all, any class with only one employee is gender-dominated by definition. Men typically fill these job classes because they often predominate in supervisory or executive positions. Therefore, the distribution of male-dominated classes is inflated.

As a result, some states have adjusted their definitions. While maintaining the 70 percent standard, they have restricted that cutoff mark to classes with a certain minimum number of employees. But that minimum varies. In Vermont,

a class must have five or more workers. In Massachusetts, it must have 10 or more incumbent employees. In New Jersey, it must have 15 or more members.

Minnesota takes a slightly different approach. While the minimum percent for determining female-dominated classes is set at 70 percent, male-dominated classes start at 80 percent.

> A higher percentage is used for the definition of male classes than for female classes because there are more men than women in state employment and in the labor force generally. Therefore, a male class must be more segregated than a female class in order to be equally out of balance.[5]

While most other states essentially adhere to the 70 percent definition, New York breaks new ground. One of its studies, conducted by the Center for Women in Government (CWG) at the State University of New York in Albany, included minority-dominated classes. This inclusion prompted CWG to use a new way of determining what constituted dominated classes, which "meant that the cutoff point would be somewhat arbitrary."[6]

The result is that female classes in the New York study start at 67.2 percent, male classes at 90 percent and minority classes at 30.8 percent. The CWG developed a formula to determine female and minority classes. It was tied to the proportion of women and minorities in the state's total work force. It also was somewhat related to the traditional 70 percent definition for female-dominated classes.

But there was another reason why the Center for Women in Government decided to change the standard for gender-dominated classes.

> ...We discovered that the 70 percent rule would exclude some of the largest titles in which historically female work is routinely performed, such as Mental Hygiene Therapy Aide, with over 17,000 incumbents, Mental Hygiene Therapy Assistant I, Housekeepers, and Launderers. Conceptually, these exclusions make little sense since these titles are clearly associated with traditionally female work. Moreover, consistent with the theoretical underpinnings of comparable worth, these titles are likely to have been misvalued because they have traditionally been done by women.[7]

In other words, low-paying job classifications that are becoming less female-dominated still must be labeled female-dominated so the gender-based wage gap can continue to be demonstrated.

The CWG uses a different basis for defining white male jobs because it contends that white men are not subject to the same discrimination in salary setting as women and minorities. Abandoning any mathematical calculations, the CWG provides the following rationale for a 90 percent mark for white men:

> The claim that jobs done mainly by white males do not experience sex or race/ethnic discrimination requires that the definition of "mainly white male" be very restrictive; it makes little sense to describe a job as predominately white male if as many as 20 percent of the incumbents are women and/or minority workers. For example, using a 67.2 percent cutoff point as the basis for defining white male jobs would, in fact, result in lower estimates of under-

valuation. However, such estimates would be lower precisely because undervaluation due to sex and race would be embedded in estimates made on the basis of such low cutoff points. On the other hand, since too narrow a definition will result in the elimination of almost all jobs, we settled upon 90 percent white and 90 percent male as the criteria....[8]

In effect, the Center for Women in Government arbitrarily decided the cutoff mark for white men based on what its researchers thought was necessary to demonstrate a racial and sex bias in state pay levels. By its own admission, adopting the same cutoff point for women and white men would result in a finding of less discrimination. Such a discovery would destroy the CWG's perception of pervasive discrimination. Therefore, the researchers "settled" on an extremely different definition for male-dominated classes--a nice round 90 percent.

One study arbitrarily decided the cutoff mark for white men based on what was necessary to demonstrate a racial and sex bias.

In addition, the Center for Women in Government decided to make several exceptions so more job classes could be tested for "potential undervaluation." The CWG made these exceptions because it was predisposed toward overestimating the number of female and minority titles. As the researchers explain:

> The criteria for selecting female-dominated or disproportionately minority titles directly determines the pool of jobs for which estimates of potential undervaluation will be made.... Thus, the goal of achieving internal equity through comparable worth adjustments is best met if we include too many, rather than too few titles in the pool.[9]

Still, several states such as Oregon, Washington and Kansas continue to use a uniform 70 percent standard, though the Kansas study urges consideration of excluding some male-dominated jobs that fail to contain a certain minimum number of workers. But even these states seem to be using an arbitrary figure. The New York Center researchers wrote:

> Despite our concerted attempts, we have been unable to discover exactly where the 70 percent-and-above definition originated. Unconfirmed data indicate that it was adopted for use in the Washington State study based on consultant use of a set of U.S. Department of Labor charts. However, our own library and computer-based searches have not uncovered a U.S. Department of Labor reference using a 70 percent definition for a female-dominated job.[10]

Nevertheless, the New York study continued to base its cutoff formula partially on the suspect number. Such lack of scientific rigor is not unusual in the comparable worth process.

Interpreting the Wage Gap

State comparable worth studies rarely investigate the reason for the apparent wage gap. The mere presence of a gap is taken to mean that further study is

required or that a comparable worth system should be designed.

The New Jersey comparable worth task force exemplifies this approach. In its interim report, the task force said "Although there is an apparent relationship between the number of points assigned to a job title and gender incumbency, this report does not attempt to determine the reasons."[11]

Instead, the task force proceeded to tinker with the job evaluation and pay system. Yet the report later noted that "There can be many explanations for the variance including social or cultural patterns, traditional employment practices, work patterns, hours, and bargaining unit agreements."[12] If the gap can be justifiably explained, the task force would not need to go through the painstaking and costly task of reforming the system.

Evaluation Teams

The evaluation teams are diverse in make-up, number and purpose. First, states tend to use an affirmative-action-style system to choose the evaluators. For instance, the evaluation team in Washington State must consist of state employees who are representative of the work force in terms of sex, race, age, occupational group and labor/management make-up. Vermont followed suit, having a mixture of genders and professions on its team.

The required team content was more specific in Iowa. Each evaluation team consisted of two men and two women, with one being a personnel specialist, another a technical/professional state employee, another a support staff employee and the last a supervisory/managerial employee.

However, Michigan preferred its team to consist of specialists from outside the state employment system. The job analysts "were either enrolled in or recently graduated from advanced academic programs in Industrial/Organizational Psychology or Labor and Industrial Relations."[13] The analysts had completed at least a master's degree in their program of study.

The state teams also differed in size and purpose. Washington State, which has conducted several studies since 1974, has one team with seven to nine evaluators. Vermont also had one team, with nine evaluators. But Iowa used 36 state employees on nine different teams. Some jobs were evaluated by one team, other jobs were evaluated by several teams and the remainder were judged by all nine teams.

In Michigan, a man on one two-member team and a woman on another two-member team rated jobs. The two analysts examined each job class. Five Arthur Young & Company consultants analyzed about 50 classifications as a further check on reliability.

The differences in approach are intriguing. Three states used state employees to judge fellow workers; another state preferred specialized outsiders. Washington and Vermont were confident about using one team of evaluators; the two other states were less secure, using different people to doublecheck the process.

Collecting Job Description Data

The task of collecting job description information also evoked a range of methods. For example, New York relied solely on "self-reports" from employees, who filled out a detailed questionnaire. The method naturally raised questions about whether employees might embellish their job duties. The Center for Women in Government, conducting the study for the Governor's Office of Employee Relations and the Civil Service Employees Association, considered having supervisors check employee descriptions for accuracy but decided against it. CWG said allowing supervisors to review questionnaires would not only disregard the confidentiality of responses "but would jeopardize crucial union support of the study."[14]

This decision would seem to violate the professed goal of objectivity and fairness in comparable worth systems. The CWG was more concerned about political considerations than the need for objective analysis.

On the confidentiality of responses, the Center explained that allowing supervisors to examine questionnaires would violate a standard of State University research ethics that "involves the protection of subjects from participating in research that involves providing sensitive information."[15]

What is so sensitive about job duties that supervisors should be kept in the dark? Such information becomes public knowledge whenever a state job opening is advertised. What is sensitive is how the information is doublechecked for accuracy. The CWG decided not to have supervisors fill out separate forms because it deemed that approach too costly and time consuming.

Besides, the Center for Women in Government argued,

> ...we were doubtful about the validity of information received from supervisors as a standard for judging the accuracy of incumbent responses. Supervisors may well be motivated to aggrandize the jobs they supervise, as much or more than incumbents are. Additionally, their distance from the duties of the jobs they supervise may give them an inaccurate picture of the jobs.[16]

The last argument seems peculiar. Supervisors must know what their workers do in order to perform their own jobs effectively. How can jobs be filled if supervisors do not know what skills a qualified candidate would need? In addition, it seems reasonable to assume that some supervisors have risen through the ranks, giving them intimate knowledge of what the supervised jobs require.

Surprisingly, the New York study used supervisor judgments as a yardstick to prove employee reliability. "Fortunately, there have been studies specifically designed to investigate the accuracy of incumbent responses to job questionnaires using supervisor responses as a standard," the CWG wrote. "These studies find that incumbents describe their jobs as accurately as supervisors do...."[17]

Michigan also relied on incumbent employees, but it collected information through structured interviews of workers. Up to 12 workers from each classification were interviewed as a group. Selections of the interviewees were based on the demographic make-up of the classification's work force and the range of its work assignments.

Whereas New York started from scratch in collecting its information, Michigan reviewed existing descriptions. Another difference was that only state employees from the Detroit and Lansing areas were interviewed because of cost considerations.

But even though Michigan's methods were more personalized, the study conductors noted that problems existed.

> A potential weakness of the data collection procedure was the necessary restriction to relatively brief interviews with incumbents as a primary information source. As a result, job analysts had no opportunity to observe actual work activity, equipment or the job environment. In addition, the communication skills, recall and cooperation of the job incumbents placed potential limitations on the amount and quality of data derived from interviews.[18]

Iowa's techniques represented a combination of the New York and Michigan methods. Questionnaires were distributed to a sample of 4,500 Merit System employees. A certain percent of questionnaires were distributed to the workers based on the size of their job class. The lower the number of employees in a class, the higher the percent of questionnaires distributed.

It is difficult to avoid the conclusion that by controlling information and glossing over differences, job consultants are able to influence the decision-making process.

The completed questionnaires were compared with Merit Employee Department classification standards and specifications for verification. Workers were interviewed when the consultants had questions.

But then the process became a matter of arbitrary judgment. "For each classification where more than five questionnaires were received, our consultants selected approximately five of these questionnaires which they believed best described the overall classification."[19] The consultants tried to explain how they determined which five responses were representative:

> This selection process was performed for two reasons. First it would have been impractical, counterproductive and often confusing for evaluation teams to read through as many as 85 questionnaires to do one evaluation. Second, we were able to choose questionnaires that were most representative of the overall classification. In addition, we were able to eliminate questionnaires potentially confusing to evaluators due to an issue of apparent misclassification or an unresolved dispute between subordinate and supervisor as to what constitutes actual job duties.[20]

It is difficult to avoid the conclusion that by controlling the information and glossing over differences, the consultants were able to influence the decision-making process.

Vermont also used employee job descriptions and interviews as ways to collect the information. In this case, however, questionnaires were sent to all

classified employees. Another difference was that the consultants interviewed 1,310 employees individually or in groups, when deemed appropriate.

Like Iowa, supervisors had some say in the process. Department heads reviewed the results part way through the process. Any concerns about proposed changes had to be supported with "factual information." Changes were made "to the extent that they were justified by the additional facts provided."[21]

But the employees will have it easier if a comparable worth system is adopted. "As a final step in assuring the validity of the changes proposed, any employees who feel they have not been treated equitably will be provided an opportunity, in a special procedure, for a review of the proposed alignments."[22]

Merging Job Categories

With the jobs described, the evaluators and/or consultants sometimes found the need to merge some job categories for positions that essentially had the same duties. Iowa is the only state with detailed information available on these job mergers.

The merging process seems simple and consistent at first. For example, entry-level fisheries and wildlife biologists are rated at 277 points. The Iowa system combines these positions into an entry-level title called conservation biologist, which is worth 277 points.

But other changes raise questions. An entry-level redemption clerk, a treasurer's assistant cashier and an entry-level accounting clerk are merged into the title accounting clerk, with 172 points. During the evaluation process, however, the redemption clerk was valued at 187 points, the cashier 179 points and the accounting clerk 172 points. These differences of seven and eight points initially may seem insignificant, but they would translate into different comparable worth pay grades. The redemption clerk is in pay grade 15, the cashier in pay grade 14 and the accounting clerk in pay grade 13.

Another example from the Iowa study involves the merging of a Clerk Stenographer 2 with a Clerk Typist 2 into a Clerk Typist 2 worth 175 points. The stenographer received 187 points, while the typist received 167 points. The stenographer is in pay grade 15, while the typist is in pay grade 13.

Notice the discrepancy between the two examples. In the first example, three positions are reclassified under the lowest title, receiving the same points and thus the same pay as the accounting clerk. In the next case, however, a stenographer is equated with a typist, yet the typist's point total is increased eight points. The new title increases the pay grade one level.

This inconsistency is not an isolated case. For the Iowa study, an Electronics Technician, a Communications Technician 1, a Traffic Signal Technician 1 and an Office Machine Repairer 2 were merged into the Electronics Technician classification. Although the Electronics Technician was worth 275 points (pay grade 22), the new title was rated at 253 points (pay grade 21), which happens to be how much the Office Machine Repairer was worth. The two other entry-level technicians were worth 248 points or pay grade 20.

Such subjective decisions made in the comparable worth process cast doubt

on the ability of this job evaluation technique to live up to its promise of being more unbiased and consistent than normal market determinations of pay.

Creating Factors

Determining what aspects of a job to evaluate seems like a simple task. The standardized systems of Hay Associates and Norman D. Willis & Associates identify four basic job factors: knowledge and skills, problem solving, accountability and working conditions.

But then the process becomes more complicated. The category of knowledge and skills is divided into managerial skills, depth of knowledge and human relations skills. Problem solving is split into latitude of independent judgment and thinking challenge. Accountability is broken into freedom to act, impact on end results and magnitude. Working conditions is fractured into physical effort, hazards and environment.

Although the Hay and Willis systems both arrived at 11 factors, the individual states ended up with different numbers. A Kansas study created eight factors; Michigan had 11 factors; Iowa, which uses the Hay plan, had 13 factors; and New York settled on 14 factors.

The process used to select these factors did raise some concern in Kansas. Its study evaluators particularly were worried because the specialized aspects of a few jobs such as licensing requirements were excluded. "The omission of such aspects, which would be considered to be compensable factors, could be a limitation on quantitative job evaluation systems," they wrote.[23]

Besides worrying about exclusions, some states fret about too many inclusions. Michigan criticized systems with redundant job factors—characteristics that measure the same aspects of jobs although they are stated in different terms. "If the measures of job value provided by these redundant factors are associated with jobs held by individuals of one sex, the evaluation of these jobs are thus overstated."[24]

Iowa made the same argument about inflating job value. But then its study contradicted itself. A consultant analysis suggested that Iowa's evaluation factors measure five major aspects of job content.

> Clearly, it suggests also there is some redundancy between the job evaluation factors....However, this redundancy can be helpful because it can enhance the statistical reliability and accuracy of job evaluation results. Just as one can get a better estimate of an individual's ability in mathematics by giving them [sic] a 100-item math test (assuming the items are reliable and valid) rather than a single item test, so too can one better estimate a job's standing on an underlying aspect of the job value identified in that factor...by measuring these aspects of the job by several job evaluation factors...rather than by a single job evaluation factor....[25]

Another limitation of these state comparable worth studies is arbitrariness, which surfaces in the New York study. In its policy-capturing approach, the study recreated the state's pay policy through statistical analyses. The Center for Women in Government took questions that determined job content and

compressed them into factors, finally settling on a 14-factor solution.

But it made a change. The CWG discarded the 14th factor because the questions for it did not group together well. It created a new composite variable called "mental demands." The new factor contained questions that had correlated "only moderately high" to an education factor. "In addition, these questions seem to be conceptually different from the education items and yet they seemed similar to one another," CWG wrote.[26] The correlation between these questions in the "mental demands" factor also were "moderately high."

In other words, the evaluators arbitrarily changed one factor they did not like into another factor that they thought better meshed with their concept of comparable worth. The questions originally correlated "only moderately high" to education, so the grouping was deemed questionable. Yet the new "mental demands" grouping correlates "moderately high" and is considered satisfactory.

Indeed, the mathematical formulas were used only as a facade for preconceived notions. CWG conceded that the decision in picking variables "is not made entirely on rigid and fixed criteria. Rather, in making decisions, statistical outcomes provided information that was used to arrive at conceptually and substantively sensible solutions....Even the choice of statistical outcome itself is a judgmental one."[27]

Weighting Job Characteristics

An especially judgmental process is the weighting or ranking of factors. Comparable worth studies acknowledge that the design of the weighting methodology decisively affects the final ranking of job classes.

How factors are weighted depends on how they are defined. Comparable worth studies frequently change the definitions of certain factors in order to correct perceived discrimination.

Weighting or ranking of factors is especially judgmental. Comparable worth studies acknowledge that weighting methodology decisively affects job rankings.

A Washington State committee exemplified the changes that are made and the rationale for them when it wrote that "The instrument itself may devalue work traditionally done by women, by emphasizing gross motor skills at the expense of fine motor skills, movement in confined spaces, and the importance of sensory decisions."[28]

Although the studies qualify their remarks with words such as "may" and "appear," they change the traditional definitions of some job characteristics with unwavering certainty. In the process, they gloss over distinctions. For example, the physical demands factor in Michigan was substantially changed "to include a physical dexterity subfactor and increased emphasis on continuously performed activities approximately equivalent in energy expenditure requirements to less frequently performed but more strenuous activities."[29]

Table 3
WEIGHTING COMPENSABLE FACTORS

KANSAS Factors [1]	Bottom Level %	Top Level %	Average %
Knowledges and Skills Required	20%	16%	18%
Complexity	20%	18%	19%
Consequences of Decisions/Actions	5%	22%	13.5%
Contacts	30%	12.5%	21.25%
Supervision/Leadership	5%	12.5%	8.75%
Environmental Conditions	5%	11%	8%
Physical Demands	5%	4%	4.5%
Visual/Auditory Demands	10%	4%	7%
8 Factors	100%	100%	100%

[1] The factors in this experimental model were divided into various numbers of levels. As the chart shows, the weighting of the factors changed as the levels became higher.

Source: Kansas Secretary of Administration, "Comparable Worth," December 1984, p. 38a.

MICHIGAN Factors	Indiv. %	Total %
Knowledge Required	11%	11%
Complexity	10%	10%
Effect	11%	
Supervisory Controls	10%	30%
Guidelines	9%	
Personal Contacts	7%	16%
Purpose of Contacts	9%	
Supervision Exercised	9%	9%
Work Environment[2]	8%	8%
Physical Activities	8%	8%
Work Pace and Context	8%	8%
11 Factors	100%	100%

[2] Work environment was divided into Risk and Working Conditions.

Source: Office of Women and Work and Arthur Young & Company, "A Comparable Worth Study of the State of Michigan Job Classifications," p. 142. Some factor scores were calculated using a constant that the study used in calculating the other factor scores.

IOWA Factors	Indiv. %	Total %
Knowledge from Formal Training/Education	15%	25%
Knowledge from Experience	10%	
Complexity, Judgment and Problem-Solving	12%	12%
Scope and Effect	10%	
Impact of Errors	5%	20%
Guidelines/Supervision Available	5%	
Personal Contacts	10%	10%
Supervision Exercised	8%	8%
Working Environment	5%	10%
Unavoidable Hazards/Risks	5%	
Physical Demands	5%	5%
Mental/Visual Demands	5%	10%
Work Pace/Pressures and Interruptions	5%	
13 Factors	100%	100%

Source: Arthur Young & Company, "Study to Establish an Evaluation System for State of Iowa Merit Employment System Classifications on the Basis of Comparable Worth," April 1984, p. 31.

This definition suggests that lifting a 75-pound box once every two hours requires the same effort as typing and lifting many smaller objects such as files and pencils during the same time period. But the "undervalued" nurse that comparable worth advocates often lament about knows that "gross motor skills" entail more risk of injury than continuously performed "fine motor skills."

Another altered job characteristic is working conditions. Although this factor traditionally has measured the physical environment, the studies include the psychological environment. The new subfactor, known as "discomfort" in the Willis system, is defined to include inflexible time guidelines, multiple roles,[30] "unpleasant social encounters"[31] and "conditions generating significant mental stress."[32]

An additional perceived problem with working conditions is that some jobs receive no points in this category under the Willis and Hay point systems. A Washington State committee found this result unacceptable. "Since working conditions are intended to reflect the negative aspects of jobs, serious consideration of the fact that all jobs have some negative aspects should be taken."[33]

After making these adjustments, the studies decide how to weight the factors. A comparison of the weightings from three states reveals incomparable results (see Table 3).

For example, Michigan gave its knowledge factor a 11 percent weight while Iowa more than doubled it to a flat 25 percent. Kansas staked out the middle ground in its proposed scheme; its average weighting (high and low values were weighted differently) for knowledge was 18 percent.

But for complexity of a job, Kansas led the pack with a 19 percent average weighting. Michigan and Iowa were about half that amount with 10 percent and 12 percent, respectively.

Similarly, or dissimilarly in this case, the factor "consequences of decisions/actions" also showed wide divergence. This factor averaged 14 percent in the Kansas weighting scheme. Iowa and Michigan did not have one factor for this aspect; they had three that amounted to the same thing. These factors totalled 20 percent in Iowa, but Michigan rated them 30 percent, its highest ranking of compiled factors.

The category "contacts" on the job displayed the largest difference between the states. Kansas' average rating was 21 percent, whereas Michigan preferred to weight it 16 percent. Iowa opted for a low 10 percent.

The value differences were far ranging. Iowa valued knowledge the highest and physical demands the lowest. Michigan rated the consequences of decisions and actions the highest and work pace and context the lowest. Averaging the top- and bottom-level scores showed that Kansas valued contacts the highest and physical demands the lowest.

These differences in the values of factors, combined with other decisions made throughout the comparable worth process, translate into marked differences in how jobs are valued, as noted in the comparison of state studies section.

Assigning Points for Levels

Consistency is the name of the game when it comes to assigning points to different levels within factors. When the levels increase in difficulty, the point totals assigned to each level must increase by a constant percentage, such as 10 percent. So if Level 1 is 20 points, Level 2 increases by 10 percent to 22 points.

But sometimes the evaluators or consultants will make an exception. In the case of Iowa, the consultants adjusted the percentage gap between the two highest levels of the "Knowledge from Formal Training/Education" factor.

> We used our professional judgment to change the relationship between the 7th and 8th degrees based upon experience in developing evaluation systems. We did this for two reasons: first the overall multiple for the factors would be too great and second we do not believe the difference between these two steps is as great as it is in the preceding steps.[34]

Point Assignments to Jobs

All of these arbitrary decisions build to the climax of this subjective process—the assignment of the total number of points to each job. Most of the studies examined here admit that all compensation and evaluation systems are subjective. But they argue that comparable worth systems are less subjective than most.

In one state study, a majority of the evaluators could not agree on point scores in 824 of the 896 classifications evaluated.

However, an examination of the instructions to evaluators on how to select points for each factor raises doubts about this claim. The instructions in a Maine study straightforwardly explained the selection process in using the Hay system. A hypothetical "First-Line Supervisor job" offers a choice of 29 percent and 33 percent in evaluating the "thinking challenge" factor. "Which one you choose is a judgment of your 'feel' of the strengths and weaknesses of the factors."[35]

The same get-in-touch-with-your-feelings methodology surfaced again.

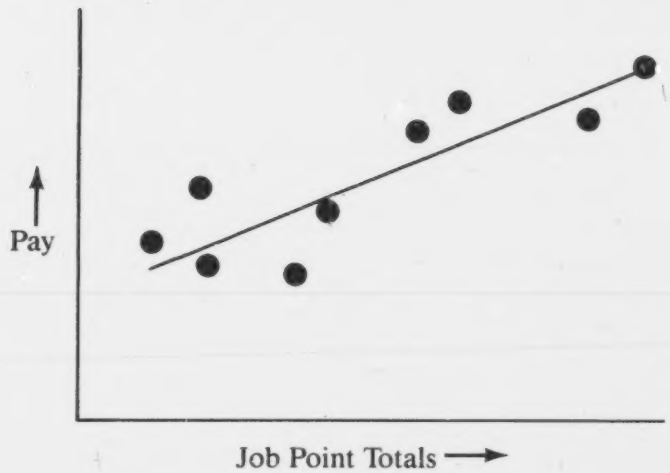
> The Know-How Chart...shows all the Sub-factors combined with three example evaluation slottings. The First-Line Supervisor shows...the number choices of 152, 175 or 200. Your final decision is to choose one of these numbers based on your "feel" for the strength or weakness of each sub-factor.[36]

In addition, the system's consultants seem to have envisioned ahead of time a distribution of points for the various jobs. "There is a general tendency by evaluators to 'overslot' in Managerial Know-How," according to the instructions. "The majority of positions will fall in I, some in II and a few in...III."[37]

The experience of the state government of New Mexico also is intriguing. The governor ordered the development of a comparable-worth-type system in 1984. A task force consisting of eight experienced personnel classification specialists was formed to choose the relative worths of different job classes.

Figure 2

THE COMPARABLE WORTH PAY LINE



Task force members made independent rankings of all state personnel classifications using the factors of skill, effort, responsibility and working conditions. Four of the eight raters agreed on the worth of 8 percent of the jobs analyzed. In other words, four or more raters could not agree on the same level for a given job in 824 of the 896 classifications evaluated.

Built-in Bias for Pay Increases

With the points distributed, evaluation committees or consultants then must decide who the winners and losers will be under the comparable worth system. To make proper use of the comparable worth evaluations, the state officials must next calculate appropriate salaries for the job classes. They set up a graph with total points of a job on one axis and salary on the other axis. The point scores and current pay levels of the jobs then are plotted on a graph such as the one in Figure 2. Next, using statistical techniques, a straight line is drawn that best fits the plotted points. In theory, if a job falls below the line, its pay would be raised until it falls on the pay line; if a job is above the line, its pay should be cut until it reaches the pay line.

One example is the Vermont proposal. If the proposed changes were implemented under the current pay scale system, 4,960 positions would move to higher pay scales, 790 would fall to lower scales and 760 would stay the same.

Taking such a winners-and-losers approach seems fair on the surface. Jobs that have been overvalued are adjusted to their lower "intrinsic" worth while undercompensated positions are raised to an equitable level. The policy also would seem appropriate for these get-tough fiscal times at the state level. If someone's salary must be raised in the process of readjusting the system, it must be made up somewhere.

Or so it would seem. But when push comes to shove, comparable worth consultants seem to be more interested in obtaining raises for the work force than in achieving a more "equitable" pay structure. "We strongly recommend that no individual receive a cut in actual pay as a result of any changes brought about by the subject study," Norman D. Willis & Associates wrote in the Vermont study. The firm went on to argue:

> On the other hand, since improved internal equity was determined to be a primary area of need, any implementation plan should focus on that principle. Individuals presently paid at higher levels than appropriate within their new ranges are already being treated relatively well. We propose that those employees receive no increases until warranted in the future by their relative positions in the new ranges, or, alternatively, receive only nominal increases compared to those granted to other employees.[38]

Notice how the recommendation leaves room for increases even when the evaluations deemed a pay cut is in order. Indeed, even if the suggested changes were made in the Vermont case, a net total of 4,170 positions out of 6,510 positions would receive raises.

Comparable worth consultants seem to be more interested in obtaining raises for the work force than in achieving a more "equitable" pay structure.

Minnesota is another state where hard choices were avoided. Pay equity did not cause any state employee's wages to be cut, nor were there any layoffs.

Iowa also was generous to its "overvalued" workers. Under its system, 445 classifications (58.7 percent) would receive pay increases, while 191 classifications (25.2 percent) would experience pay cuts. However, Iowa decided to use "red-circling." Under this concept, employees with current wages above their new salary ranges would be ineligible for any wage increase as long as their wages are higher than the adopted salary range. Red-circling maintains a built-in bias for an overall pay increase in the comparable worth system, but it would seem to be more consistent than Vermont's proposed treatment of overvalued employees.[39]

Yet even this quasi-equitable policy sometimes displeases a comparable worth task force. In Oregon, where a red-circling law is on the books, "the Task Force will recommend some alteration of this law for current employees," according to the task force's February 1985 report.[40] Why? Although no reason is given, the fact that the chairwoman of the task force is an employee of the Oregon Public Employees Union does raise questions about the objectivity of the recommendation.

Other Problems with Comparable Pay

Even when the pay policy seems settled, other problems can surface. Washington State, which started its comparable worth studies in 1974, has faced

at least two dilemmas in trying to refine its process, which is about to be implemented. The following is one such dilemma in determining the eligibility for comparable worth pay.

> In a job series there may be a logical relationship between the points and the salary spread among levels, e.g., jobs that are paid 10% apart may have point levels that are 10% apart. On the other hand, two levels of jobs paid 10% apart may evaluate at the same or nearly same point level. Occasionally a job with few incumbents which is only peripherally related to a particular series may be evaluated very differently from its pay relationship to the series. When situations such as these occur, a decision must be made relative to which is correct: the salary relationship or the evaluated level.[41]

So even after doing all the work in the phases leading up to assigning a salary, the pay level still may come down to an arbitrary decision: Which do you prefer, the salary relationship or the evaluated level?

But a state task force can avoid such a messy problem early on in the process. In the case of New Jersey, an interim report by its task force concluded that base pay for jobs rated at ranges 1 through 4 be increased to range 5. Although the task force had not yet determined the reasons for pay variance,

> ...it is clear to the Task Force that a portion of the variance in State service is due to: 1) the lower end of New Jersey's salary rates not rising in proportion to rates at the upper pay levels; and, 2) entry-level jobs requiring a minimal amount of knowledge or experience being paid at differing ranges.[42]

Of course, such a major increase compresses the salary ranges, so the task force also recommended that employees in ranges 5 through 8 be increased by one range. In total, the price tag on this "first major step towards pay equity" would be $7 million.

But the remedy still somewhat compresses the salary ranges above range 8. The task force explained:

> Some compression may still occur, but to raise the ranges above range 8 may create some adjustment in the system that would hinder the larger study being done by consultants. The majority of the Task Force agrees that while the immediate remedy will bring about some degree of pay equity and provide a strong foundation for future actions, it may not change the system in any way that would hamper the extended study.[43]

But by lumping the jobs in ranges 1 through 4 together, the task force failed to distinguish between different tasks. While the tasks may require "minimal skills and no prior experience," the tasks may require skills of differing importance and value.

The task force also failed to consider the effects of the recommendation on employee morale. A worker in range 4 is raised one pay range, while an employee in range 1 is increased four ranges. The range 4 worker is bound to be confused by the action, especially when no other reason is given except that a range 4 worker and a range 1 worker require "minimal skills and no experience."

Conclusion

This study shows the comparable worth evaluation process is filled with inconsistencies and arbitrary decisions. The definitions of male- and female-dominated job classes are different for the various states studying the concept. States vary on the composition, number, size and purpose of evaluation teams. They differ in the way to collect job description information. They diverge on the critically important step of valuing job characteristics. But most damning of all is the result of this series of subjective decisions—the same jobs have significantly different "worth" from state to state. The results of this analysis largely substantiate the arguments of comparable worth critics who say the process is arbitrary and capricious.

The evidence also supports those who worry that comparable worth will burden the states' coffers. An overall pay increase is built into a system that claims to address the issue of discrimination. Garbed in such rhetoric, pay increases can be and have been approved in belt-tightening times. As the Oregon and New York State studies show, the presence of a union official or the worry of gaining the support of public workers' unions influences the thinking of comparable worth task forces and causes arbitrary decisions that can cost taxpayers substantial amounts of money.

Comparable worth is not inherently restricted to the realm of state government....Already, advocates are seeking to "reform" the private sector.

But comparable worth is not inherently restricted to the realm of state government. Many comparable worth bills have been introduced in Congress. The legislation typically advocates only a "study." Yet the presence of such a study was instrumental in a Washington State court case in which a federal judge ordered the establishment of a comparable worth system for the state government. After winning a reversal on appeal, Washington recently settled with its employees union on a comparable-worth-based salary adjustment that will cost an estimated $482 million over five years.

Already, advocates are seeking to "reform" the private sector. A California task force is studying ways to adopt comparable worth into businesses as well as state and local governments. The private sector can expect to suffer from the same arbitrary decisions and inconsistencies that plague current comparable worth plans, if the results of this study are any indication. If companies were brought into the comparable worth fold, bureaucratic fiat would substitute for marketplace competition in determining the largest portion of the cost of production—wages and salaries of employees. Indeed, comparable worth techniques would institutionalize bias and subjectivity in the pay evaluation system.

Comparable worth is hailed by supporters as an idea whose time has come. This study reveals that despite the best of intentions, comparable worth studies and systems are neither comparable nor worth the resources expended on them.

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Learning to Compete:

Feedback Effects of the Non-Linear Economy

by Murray Weidenbaum with Richard Burr and Richard Cook

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Introduction

After a period of rapid expansion in 1983 and 1984, the American economy is visibly slowing. Pessimists talk about the coming recession in late 1986 or early 1987, while the optimists see economic growth during the next several years at a rate that at best is only one-half of the 1984 pace. Simultaneously, fears of debt crises—farm and urban, domestic and foreign—are increasingly expressed. Moreover, concerns about import penetration and the resultant job losses are rising even more rapidly than the flows of goods and services from overseas. All this creates an uninspiring if not dismal economic outlook in the minds of many.

On reflection, the discouraging talk relies on the oldest and simplest method of forecasting: extrapolating the most current experience. As Patrick Henry so eloquently said, there was only one lamp by which his feet were guided, the lamp of experience. But he was not limiting himself to the last two yards that he had walked! In the broader perspective of American economic history, there is little support for the simpleminded approach to predicting economic trends. Rates of expansion vary greatly, and periods of growth and decline alternate.

A common pitfall awaits people who apply the experience to which Patrick Henry referred to in too limited and too simple a fashion. For example, the forecasts in Figures 1A and 1B rely on that fundamentally accurate but often misleading postulate of geometry: Two points determine a straight line. Thus, merely extending the most recent experience in 1982—a sharp decline from 1981—would have resulted in expectations of an accelerating recession in 1983 and 1984 (see Figure 1A). That would have missed entirely the strong recovery that occurred during that period. In only slight exaggeration, it may be said that this approach was widely followed; it typified the pessimism of those who, in 1981 and 1982, were writing about the fundamental weakness of the American industrial economy and advocating ambitious industrial policy approaches to deal with that situation.

An example of such thinking was provided by Ira Magaziner and Robert Reich in 1982. They wrote in *Minding America's Business*, "The U.S. economy is in crisis... In the absence of new strategic directions, the crisis can only deepen."

Similarly, extrapolating the sharp growth of 1983 and 1984 in the same simpleminded linear fashion would have yielded a misleading "up, up and away" forecast for the present (see Figure 1B). In essence, this was the spirit of the more optimistic supply-siders who expected unbroken prosperity to result from the 1981 tax cuts.

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THE HAZARDS OF FORECASTING A LINEAR ECONOMY

Figure 1A

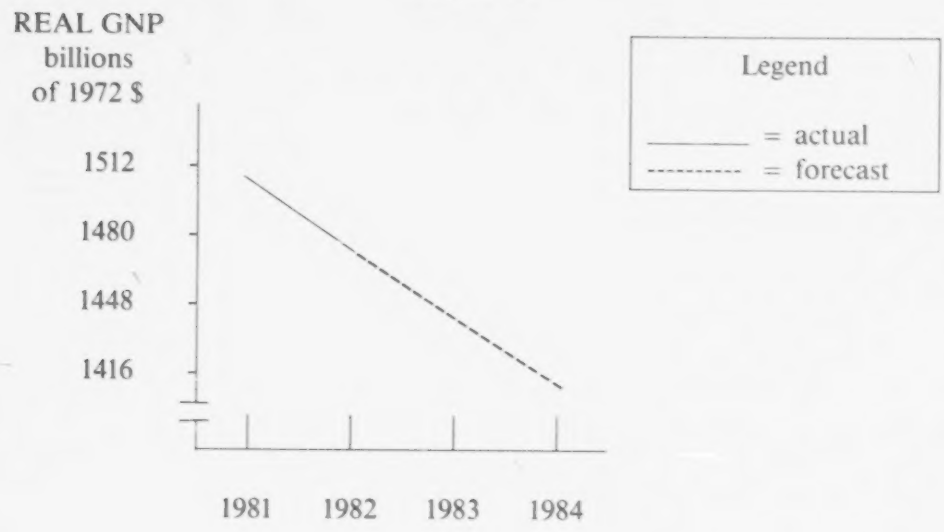
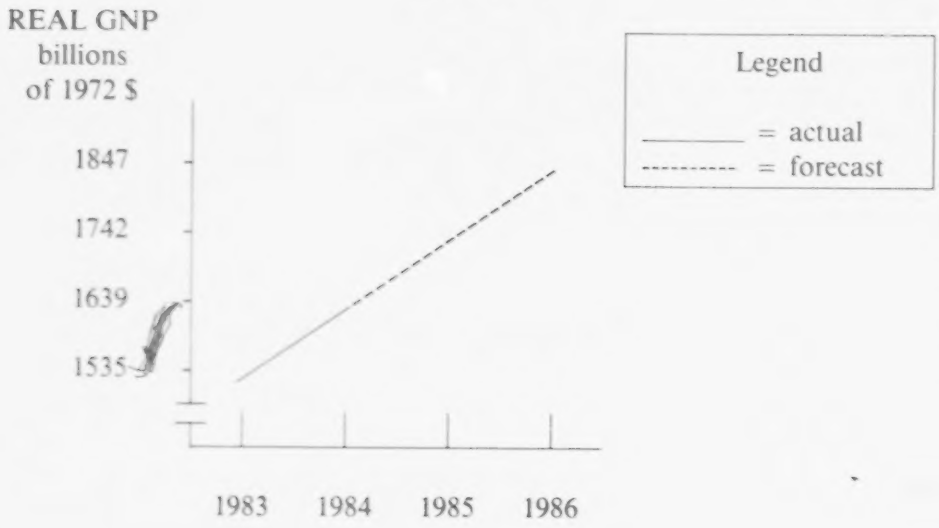


Figure 1B



There is great danger that the latest two points in economic experience will continue not only to determine a straight line for the short run, but to influence excessively expectations for the long run. Thus, during this current period of short-term economic slowdown, many analysts are decreasing their long-term projections—their expectations of the growth of the American economy—for the entire decade ahead.

Sectors of the American economy most heavily affected by imports are responding far more dramatically. Here the often-prevalent voices of doom and gloom contend that the recent penetration of U.S. domestic markets by foreign producers will not only continue but likely will accelerate. A similar cry echoes from other sectors of manufacturing, where observers see only a decisive shift to services in the future.

John Naisbitt's 1982 book, *Megatrends*, helped to set this mood with statements such as, "It's becoming clear that yesterday is over, and as the Third World prepares to take over the major industrial tasks, the developed countries must move on to the new enterprises." More recently the chief executive of a major chemical corporation embellished this negative sentiment when he described the competitive environment as "a zero-sum global economy." In his view, this means that "if individual companies expect to grow they will increasingly have to do it at someone else's expense."

U.S. economic history clearly shows that Americans do not live in a linear world. During "hard times," steps are often taken that provide the basis for future expansion.

In each of these cases, the implicit forecasting approach used is to extrapolate naively the most recent experience. Yet U.S. economic history clearly shows that Americans do not live in a linear world. For one thing, important feedback effects occur. During periods of extremely rapid growth, marginal resources are brought into production, lowering productivity while raising costs. This contributes to inflationary pressures, which lead to changes in economic policy—notably a move to restraint—that halt the expansion.

Thus, rapid growth in the first half of the 1950s (with an average annual increase in real GNP of 4.7 percent) was followed by a slower pace in the second half of the decade (3.2 percent yearly). Similarly, a strong growth pace in the 1960s—when real GNP increased at the average rate of 4.2 percent a year—was followed by the slower 3.3 percent rate of the 1970s.

During "hard times," steps are often taken that provide the basis for future expansion. These include those cost-cutting, product and process innovations and other productivity-raising moves that help to turn the tide. The United States is experiencing such a period right now. There are three key forces that make a period of sustained prosperity in the decade of the 1990s more likely:

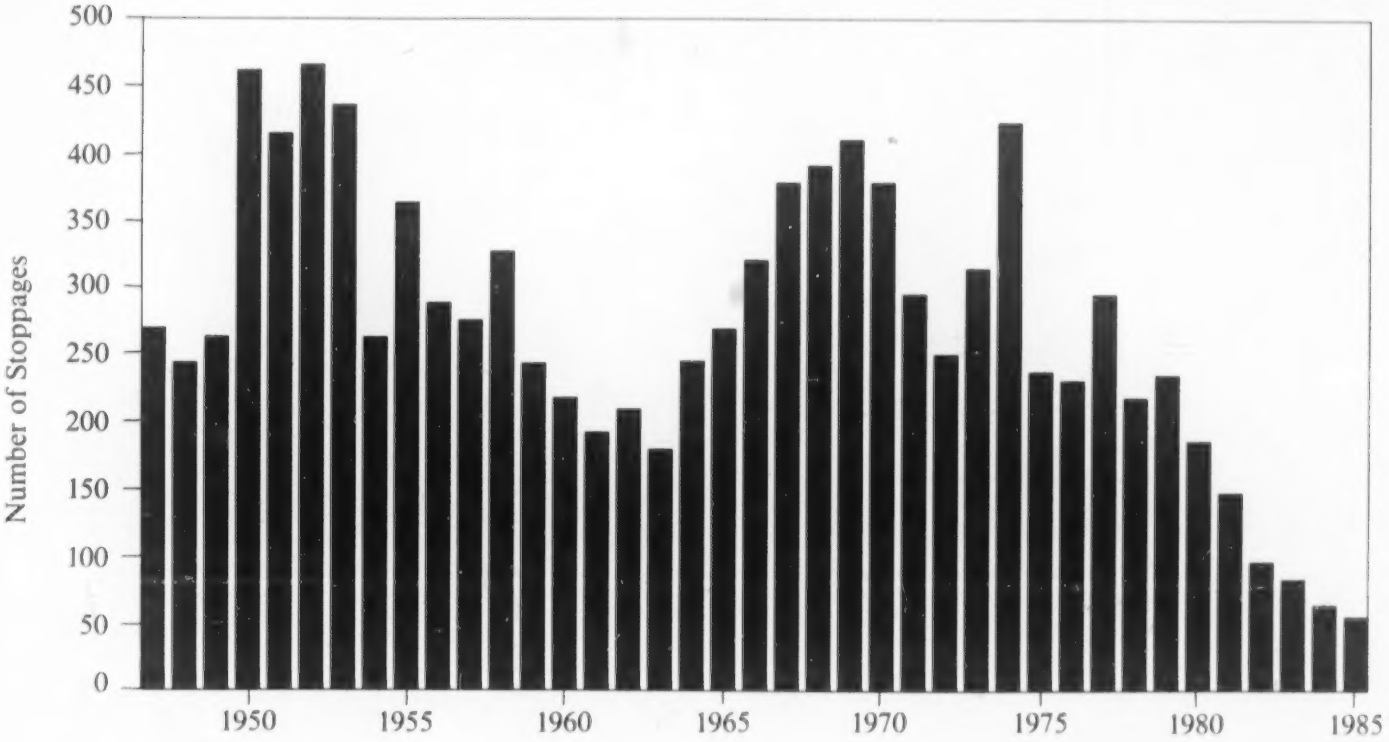
(1) A variety of actions that reduce the cost of producing goods and services in the United States.
(2) New awareness of personal responsibility for the quality of what Americans produce.
(3) More rapid growth in investments in research and development, the basic fuel for innovation and technical progress.

Let us examine the growing importance of each of these key forces.

Figure 2

WORK STOPPAGES INVOLVING 1000 OR MORE WORKERS

1947 - 1985



Source: U.S. Bureau of Labor Statistics.

Reducing the Cost of Production

For a variety of sensible reasons—most notably to keep up with foreign competition—many American business firms have taken actions during the past several years that reduce the domestic cost of production. These actions range from simple changes in production methods to a basic restructuring of the business firm. Since compensation of employees constitutes about two-thirds of the cost of producing the nation's output, labor costs are a natural starting point for cost cutting.

Reducing Labor Costs

The measureable changes that are occurring in the labor market are dramatic. For example, the 54 strikes involving 1,000 or more workers in the United States during 1985 were the fewest since 1947, when the Labor Department first began compiling such statistics. In addition, the 324,000 workers involved in the strikes was the lowest number of strikers on record. Figure 2 shows vividly the non-linear nature of the history of labor-management disputes in the United States since the end of World War II. In any event, the American economy is enjoying a sustained period of domestic labor peace.

More fundamentally, competitiveness has been enhanced by the substantial slowing of the rise in nominal wage costs. In 1980, the average worker in the private sector in this country received a 9.0 percent wage increase. By 1984, the average annual increase was down to 4.1 percent (see Table 1).

Perhaps surprising to the proverbial man on the street, the change also turns out to be beneficial from the workers' viewpoint. In real terms (after boiling out the effects of inflation), the average worker in 1980 suffered a 0.2 percent decline in real wage rates. In contrast, 1984 witnessed a real increase of 0.3 percent—a modest change but in the desired direction. The downward trend in nominal wage costs was similar in both manufacturing and non-manufacturing sectors.

Moreover, the pace of negotiated wage increases in union agreements has slowed visibly. During the past four years, some groups of workers have actually experienced wage cuts (see Table 2). For example, in 1980, 71 percent of the workers covered in major collective bargaining settlements received an annual wage increase of 8 percent or more. By 1985, only 4 percent of the workers were in that category—and 26 percent received no increase or actually suffered a decrease. Looking ahead, the Conference Board's Labor Outlook Panel is forecasting a modest 3.6 percent overall increase in average hourly earnings in 1986.

Some analysts see a further shift in the relative bargaining power of management and labor resulting from greater use of "contingent" employees. For example, companies that are trying to respond to rapid market changes, especially due to foreign competition, are increasingly using temporary and employee-leasing arrangements. Contingent employees also serve as a buffer to protect the security of regular employees.

Table 1

THE DECELERATION OF EMPLOYMENT COSTS
Annual Percent Change in the Labor Cost Index, 1980-1984

Sector	1980	1981	1982	1983	1984
Total Private Non-Farm	9.0%	8.8%	6.3%	5.0%	4.1%
By Industry					
Manufacturing	9.4	8.7	5.6	4.3	4.4
Durables	9.9	9.2	5.6	4.1	4.1
Non-durables	8.6	7.7	5.8	5.6	4.9
Non-manufacturing	8.8	9.0	6.5	5.5	4.0
Construction	8.7	8.8	5.2	4.5	1.3
Transportation and Public Utilities	11.2	8.4	7.2	7.3	3.3
Retail Trade	7.0	7.5	4.1	4.7	5.1
Wholesale Trade	10.0	7.8	6.2	4.8	5.5
Finance, Insurance, and Real Estate	7.4	9.9	6.5	8.5	–.9
Services	8.8	10.6	8.0	6.0	6.2
By Occupation					
White Collar	8.7	9.1	6.4	5.9	4.4
Blue Collar	9.5	8.6	5.6	5.0	3.6
Service Workers	8.1	8.5	8.5	5.2	6.2

Source: U.S. Bureau of Labor Statistics.

Increasing Productive Efficiency

While management negotiations with unions are stabilizing labor costs, import penetration has sparked a war on other costs. In addition to holding down the cost of labor, firms are attempting to get more for the labor dollars they do spend by improving productivity. More flexible work rules and improved worker attitudes are two of the more important methods being used.

Loosened work rules can generate important savings in the production process. The traditional way was to have narrow job classifications, with each

employee performing one task. With new agreements to perform a number of different tasks, however, fewer workers are required or the same number of workers can produce more. Also, there is less down time due to waiting for a worker with the right classification. This illustrates one among many efficiencies—large and small—which, in the aggregate, can result in substantial increases in productivity and hence competitiveness.

For example, a Chrysler plant in Indiana has reduced labor costs 30 percent or $2.8 million a year by getting workers to agree to perform tasks outside their crafts. Goodyear has signed a pact that allows the 429 craftsmen at its Alabama plant to work outside their trade as much as 25 percent of the time if necessary. General Motors successfully negotiated with its Manville, Ohio, union to eliminate jobs such as machinists' "tool chasers." Having machinists get their own tools and other changes raised productivity in one stamping plant by 26 percent.

Work-rule changes also have saved money in the petroleum industry, where refiners report that output per worker increased by more than 10 percent in recent years. One oil company, American Petrofina, merged six classifications into two at one refinery, cutting the workforce by 25 percent. The move saved $4 million a year.

Table 2

WAGE RATE CHANGES FOR MAJOR COLLECTIVE BARGAINING AGREEMENTS

Percent of Workers by Category of Wage Change, 1980-1984

First-Year Wage Adjustment	1980	1981	1982	1983	1984	1985 (first six months)
Decrease	0%	5%	2%	15%	5%	4%
No change	0	3	42	22	18	22
Increase						
0-4 percent	4	3	9	14	44	38
4-8 percent	25	9	23	39	30	33
8 percent and over	71	81	24	10	2	4
Average Percent Change	9.5	9.8	3.8	2.6	2.4	2.8

Source: U.S. Bureau of Labor Statistics.

Some companies have attempted to improve worker attitudes on the reasonable assumption that more motivated workers do better quality work. At Jones & Laughlin, a major steel maker, a labor-management participation team analyzes production problems and suggests ways of improving efficiency. The company saved $75 million in 1982 largely because of employee suggestions and workforce cutbacks that resulted in the remaining workers being assigned more duties.

The Harley-Davidson Motor Company is also making great strides. Although the motorcycle maker has been protected by high tariffs, those tariff rates will decline automatically to 4 percent in 1988 from the 24 percent level levied in 1985. The prospect of dwindling protection has caused the company to adopt Japanese management techniques that are partially responsible for making it profitable again.

Indeed, Harley-Davidson has attracted executives from other companies to its monthly seminars on efficient management. The firm has sharply decreased absenteeism by maintaining an open-door policy with workers and discussing employee complaints. Costs of fixing motorcycles on warranty have plummeted as a result of a new commitment to quality, the company says. This experience is not now unique in American industry.

But tough negotiations with labor can cause backlashes. United Airlines pilots, angry because they believe the company tried to break the Air Line Pilots Association during a 29-day strike in 1985, are reportedly wasting fuel. A veteran United pilot told a reporter that an "awful lot of pilots are burning more gas. We're not interested in saving money for the company any more."

Changes in Production Approaches

Several American companies have adopted the Japanese just-in-time inventory system in which components are provided as needed instead of having large batches made in advance and stored. Harley-Davidson, for example, reports that the system freed $22 million previously tied up in inventory at a York, Pennsylvania, plant alone and dramatically reduced reorder lead times.

A Chrysler plant in Fenton, Missouri, also is using the just-in-time approach. The system cut its inventory to $20 million from $29 million, resulting in about $1 million a year savings in interest costs. Reduced inventory also has meant less damage to parts from overcrowded storage conditions.

One of the most ambitious production improvement efforts to date is the General Motors Flint Assembly project, which is converting a 60-year-old complex of unrelated component manufacturing and auto assembly plants into a 500-acre integrated production facility.

The Flint Assembly Complex builds, virtually under one roof, most of the major components needed for the front-wheel drive vehicles that replace the Buick LeSabre and the Olds Delta 88. The work performed includes engines, transmission components and complete bodies. In effect, steel blanks for body construction enter at one end of the plant and finished cars leave at the other. Previously, partially completed automobile bodies were built at a body plant

on the other side of town and shipped to the final assembly location.

A key element at Flint is the just-in-time system of inventory management. The complex operates without the usual "safety net" in a conscious effort to force discipline into a manufacturing system that formerly operated with convenient, but expensive, fallback positions. If a quality problem now arises in any part of the system, it must be corrected immediately. Otherwise, the entire production operation may grind to a halt.

Proponents of pursuing joint ventures with Japanese and South Korean companies defend it as a way of saving some American jobs; opponents view such out-sourcing as "exporting" of jobs.

As might be expected, considerable investment is required, especially in the company's workforce. Between 4,000 and 5,000 employees are receiving training in new technical skills in three Flint-area educational institutions. Building on the ongoing Quality of Work Life program, union officials participated in the planning of Flint Assembly throughout its development.

Out-Sourcing. Each of the major auto producers is pursuing joint ventures with Japanese and South Korean companies as a long-term way of cutting costs on small cars. Proponents of this approach defend it as a way of saving some American jobs, while opponents view such out-sourcing as "exporting" of jobs. In any event, General Motors has at least four separate agreements with Japanese and South Korean affiliates to supply up to 500,000 cars a year to its U.S. dealers. Ford has contracts pending with Japan's Mazda Motor Corporation and Korea's Kia Industrial Company. Chrysler has signed ventures with Mitsubishi Motors and Samsung Corporation.

The American steel industry is seeing the benefits in a similar arrangement. National Steel Corporation, which is half-owned by Nippon Kokan, has enhanced its productivity. In the first year of Japanese involvement, National increased the amount of prime finished product made from molten steel by 3 percent. National Steel President Robert McBride estimates that a 1 percent increase in product yield adds $20 million to the company's profitability.

Caterpillar Tractor Company, the world's largest manufacturer of heavy construction equipment, also has learned this lesson. The company reached its goal of slashing costs by more than 20 percent by the end of 1985, a year ahead of schedule. It has reduced its workforce by one-third and increased the number of parts it acquires from outside. Caterpillar's efforts seem to be paying off. The company reported a fourth-quarter 1985 pre-tax profit of $87 million, compared with a loss of $251 million for the same period in 1984.

Targeting Capital Spending. Simultaneously, the composition of new capital spending by American industrial firms has shifted away in large measure from additions to productive capacity and toward replacement of existing machinery and facilities with more efficient equipment. For example, the outlays for new plant and equipment devoted to computers and instruments rose from $28

billion in 1970 to $142 billion in 1983. Such changes curb the unit cost of production rather than expand the total amount of product.

In some cases, the use of new technology can result in products manufactured more efficiently than at modern foreign plants. One ton of steel production at Chaparral Steel is estimated to use 1.8 man-hours, whereas the Japanese on average require 2.3 man-hours. Another steelmaker, Timken Company, invested $500 million in an advanced mill in the midst of the last recession. The new facility makes better quality steel for its tapered roller bearings, the anti-friction devices Timken invented.

Other Strategies. Price reductions forcing cost containment have emerged as the dominant way that American firms respond to import pressures. But it is clear that they rely on other approaches simultaneously. In addition, there are many variations on the price or economizing approach to meeting foreign competition.

For example, in the auto manufacturing industry for many years operations had been based on achieving economies of scale via high-volume, long-running production with fairly rigid product specifications. Because economies of scale emphasized large factories and standard product design, changes in the product could become expensive. Today, as a result of a shift to computer-based manufacturing, production can be based on economies of scope. This newer approach allows for low-cost, flexible production of a variety of products on the same automated equipment.

An extension of this economizing strategy is leading to important structural changes in a great many of the larger American corporations. The horizontally integrated firm, producing virtually every product in the markets in which it operates, is becoming less prevalent. Many companies are preferring to specialize, focusing on specific product niches that are secure against foreign competition.

On reflection, this is to be expected as U.S. firms find themselves competing more fully in a global economy. Surely far fewer of our domestic markets can be properly thought of as part of a closed economy.

In an ambitious restructuring effort, General Electric raised about $5 billion since 1981 by selling off 155 divisions. Among them were GE's small-appliance operation, which manufactures toasters and irons, and Utah International, a natural-resource subsidiary.

The company's new strategy is to move gradually away from traditional manufacturing and to focus instead on growth industries such as electronics and financial services. The $5 billion proceeds from its restructuring activities helped to finance its acquisition of RCA, a move strengthening GE's position in electronics and services.

The Union Carbide Corporation, a firm under severe pressure for many reasons in addition to foreign competition, also has undergone extensive restructuring. It has divested $500 million in what it now views as "non-strategic" assets

and businesses, including its commodity-metals business and its European bulk-chemical, plastics and polyethylene businesses. Carbide also wrote down other assets totalling $865 million, including petrochemicals, metals and carbons segments. At the same time, the company built an industrial gases plant in Spain, acquired a consumer products business in France and entered an industrial gases joint venture in Italy.

Companies also are combatting imports with financing innovations. Major U.S. car manufacturers have increased sales by providing low-interest-rate financing on new cars. In effect, this means squeezing profit margins in an effort to remain competitive.

In addition, a rapid rate of product innovation has been emphasized. American shoe firms such as Timberland Company, Reebok International and Rockport Company have responded with stylish footwear to ward off foreign competition. Even apparel manufacturing, one of the most import-affected industries, is using style to compete with low-cost foreign products. Companies such as RJMJ Inc. continue to make a profit selling women's pants and shorts through improved timing and greater flexibility of production. Whereas foreign apparel makers need at least six months' lead time to coordinate manufacturing with retail sales, RJMJ's president says his company "can turn on a dime. We can get piece goods to [our plants] in a day or two and produce products for the shelves in three to four weeks. That enables us to catch a trend."

The Influence of Government

Meanwhile, government actions to reduce the value of the dollar in world currency markets are helping American firms to compete more effectively both at home and abroad. Despite some softening in the dollar in 1985, the average value of the dollar in relation to other major currencies (the "trade-weighted" dollar) remains almost 40 percent higher than the level in 1980. This is the equivalent of a special 40 percent tax levied on American producers, exacerbating other cost differences with their foreign competitors.

A significant weakening of the dollar would enhance the effectiveness of the various private-sector strategies to restore the competitiveness of American firms.

There are many reasons for the strong dollar. Some of these are inherently favorable, such as the worldwide view that the American economy is a major "safe haven" for investors. There is little concern here about expropriation or the other arbitrary governmental actions that have occurred so frequently overseas and have increased the relative risk of investing in many other countries.

But some of the reasons for the strong dollar are not so benign, such as the massive budget deficits whose financing has forced real interest rates up so high. That, in turn, has increased the foreign demand for dollars and in the process raised the "price" (or exchange rate) of dollars.

Recent governmental policies and actions have attempted to restore the U.S. dollar to its earlier exchange rate relationships. The passage of the Gramm-Rudman-Hollings bill represents a congressional and presidential commitment to eliminate the federal budget deficit by 1991. The specific budget cuts needed to achieve that goal, however, have not yet been designated by the Congress or the White House.

Simultaneously, Secretary of the Treasury James Baker has embarked on an international cooperative effort to encourage the downward movement of the dollar in foreign exchange markets. A significant weakening of the dollar would enhance the effectiveness of the various private-sector strategies to restore the competitiveness of American firms and of the goods and services that they produce and sell. But lasting changes in exchange rates require more substantive actions than merely financial intervention by governments in international currency markets. Sustained improvements in monetary and fiscal policies are required.

Improving the Quality of U.S. Products

An important lesson that American companies have learned in recent years is that "Made in Japan" (or South Korea or Taiwan) is no longer synonomous with shoddy quality. In fact, the inroads of foreign competition into U.S. domestic markets have frequently been caused by the superior quality of the import rather than just lower cost. As a result, unprecedented pressure has been generated for improving the quality of products that American businesses manufacture.

A 1985 poll on product quality showed mixed results. In many product categories, American-made items were rated as being of higher quality than the corresponding import (see Table 3). Important examples of perceived U.S. superiority in quality included furniture, clothing, personal computers, appliances and—by a smaller margin—automobiles. However, the survey also showed that 45 percent of the respondents viewed imported consumer electronics goods (televisions, radios and VCRs) as being of higher quality, while only 40 percent thought the same goods made in the United States were of higher quality. Many recent actions by U.S. companies to deal with the quality challenge demonstrate the feedback effects of our non-linear economy.

Meeting Domestic Quality Requirements

Many U.S. firms are responding positively to the consumer preference for quality. For example, Steinway & Sons, the well-known piano manufacturer, facing rising competition from Yamaha and Kawai, has improved the quality of its pianos, which remain popular with concert pianists. The company proudly recalls that 35 of the 37 Asian contestants performed on Steinway grands at a recent international competition.

Despite increased imports, Steinway & Sons is forecasting increased sales. Steinway President Lloyd Meyer contends that American manufacturers generally have rested too long on their laurels and allowed importers to equal them in quality. "I blame management for losing the quality edge," Steinway Company's president maintains.

Indeed, ignoring or de-emphasizing quality can be costly, as a Harvard Business School study of the air conditioning industry demonstrated. Professor David Garvin found that the failure rates of room air conditioners from the lowest-quality producers were between 500 and 1,000 times greater than those from the highest-quality producers.

Garvin analyzed Japanese and American firms in an industry where practically the same assembly-line processes and manufacturing equipment are used

Table 3

U.S. CONSUMERS' VIEWS ON PRODUCT QUALITY
July–August 1985 Survey

Item	Percent Viewing U.S. Goods as Higher Quality	Percent Viewing Foreign Goods as Higher Quality
Furniture	84%	4%
Major appliances	78	6
Clothing	70	13
Small appliances	58	19
Automobiles	46	38
Personal computers	41	22
TVs, radios, VCRs, etc.	40	45
Weighted Average	53%	14%

Source: American Society for Quality Control.

to make an essentially standardized product. Therefore, the staggering differences in performance between Japanese and American firms could not be attributed to differences in technology or capital.

Japanese companies were reported to be far superior to their U.S. counterparts in many measurable ways. The average U.S. assembly-line defect rate was almost 70 times that of the Japanese and their average first-year service call rate nearly 17 times the Japanese service call rate. Products made by the worst Japanese company had an average failure rate less than half that of the best U.S. manufacturer.

The key payoff of higher quality comes from the savings realized from avoiding the costs of reworking defective products or replacing defective parts. Garvin noted that "failures are much more expensive to fix after a unit has been assembled than before." In addition, customer complaints about products—even when they are subsequently replaced—often result in the long-term erosion of a company's customer base.

Westinghouse Electric is an example of a corporation that can show benefits from emphasizing quality. It has established 2,000 quality circles involving 20,000 employees and a Quality College to foster participative management and quality training. The result has been that Westinghouse has averaged real productivity gains of 7 percent a year for three years in a row, 1982 through 1984. Thomas Murrin, president of Westinghouse's energy and advanced technology group, says such a result "means that every 10 years you double your output without adding any resources."

Emphasizing quality has also profited Harley-Davidson. Management places more responsibility on the individual worker, coaching employees to evaluate their own work and improve the quality of the components. All employees receive 40 hours of training in statistics so they better understand how to measure the quality of their output and improvements in it. The moves have caused a rise in defect-free motorcycles coming off the assembly line. Whereas 50 percent of the motorcycles were free of defects five years ago, 99 percent are now reported to be flawless.

High-technology industry also is concentrating on quality. In 1980, Hewlett-Packard tested semiconductors from three American companies and three Japanese firms, and found that the Japanese failure rate was one-sixth that of the U.S. producers. But the American firms virtually had closed the gap when the same test was made two years later.

America's automakers, long regarded as the epitome of old-line industry, are also making substantial strides. On a crash program to close the "quality gap" with their foreign counterparts, particularly the Japanese, domestic automobile manufacturers have been pressuring American steel manufacturers to improve their performance. Three years ago, for example, Ford was rejecting and returning nearly 9 percent of the steel it purchased from suppliers because of surface defects or faulty chemistry. Now the rate has been reduced to less than 2 percent.

One way of improving quality is to iron out the bugs in the assembly process before shipping the product. GM took this step in its new Wentzville, Missouri,

facility. The announcement was unusual apparently because the company's—and the industry's—previous practice was to iron out these problems while continuing production. Quality problems in the past were thus passed on to the dealers and customers to avoid the huge costs of halting production.

A somewhat similar experience occurred in the fall of 1985 in Ford's automotive operations in Dearborn, Michigan. Production was delayed because the rear doors were not meeting the rear fenders correctly. Ford executive Lou Ross was quoted as saying, "Ten years ago, confronted with the same problem, we would have built on the appointed day. Today . . . we start when we meet the standard."

The scene was repeated at a Detroit-area GM plant, where faulty Cadillacs and Chevrolet Caprices remained in the repair lots instead of being shipped to the dealers. "What really blows the minds of people today is that we won't ship cars if we don't have the quality right," says GM spokesman Clifford Merriott. Unintentionally repeating Ford's estimate, he adds, "There's no doubt that 10 years ago we would have shipped those cars."

"Ha! Ten years ago?" says M.L. Douglas, president of the United Auto Workers' Local 22. "It's more like two years ago . . . But people are beginning to realize that we just can't do things like that anymore." In retrospect, how could the average worker on the production floor have been expected to really care about quality when management appeared to be so indifferent?

Pushing faulty cars out the factory door also can be expensive. Chrysler learned that lesson when it tried to meet a deadline on the Plymouth Volare/Dodge Aspen models in the mid-1970s. "Not doing any galvanizing on the Aspen/Volare cost us $100 million because of rust," Chrysler Chairman Lee Iacocca says. The rest of the industry seems to have learned the lesson. Ford now allows 36 months from car design to production instead of the former 28 months.

Auto companies also have improved quality through quick response to defects in parts. Chrysler's Fenton, Missouri, plant now corrects problems with parts in two days. A decade ago, the turnaround time could have been as much as 20 days.

Catering to Foreign Customers

- Quality is not only important to American consumers, but especially to foreign consumers, notably the Japanese. Ocean Foods of Astoria, Inc. in Oregon has capitalized on the Japanese consumers' characteristic concern for higher-quality products, making Japan one of its principal markets. "They'll pay top dollar for your product, but only if it's of absolute top quality," says Grant Larson, vice president of Ocean Foods. "They are unmovable when it comes to quality control."

Ocean Foods pays special attention to detail in its food processing to ensure mandatory quality control for the finicky Japanese. In the words of one senior executive of the firm:

When we catch the fish, they are eviscerated and stacked a precise way. Then

the fish are flash-frozen. If the salmon aren't arranged this way prior to freezing, some of them will freeze at uneven temperatures. The flesh can become slightly discolored, or part of a tail will stick to the salmon below or above it and break off. If there is the slightest discoloration of the fish, or if part of the tail is broken off, forget it. You just won't sell that salmon [to the Japanese].

Other U.S. companies are apparently realizing the appreciation that the Japanese have for quality—the average consumer in Japan spends about $600 a year on American-made goods (the average U.S. consumer spends only $290 a year on Japanese products). Although few people in Japan had heard of Cross pens a decade or so ago, they have become a status symbol and are considered a most desirable business gift. Comparable results have occurred for other overseas competitors in Japan. Bondhus Corporation hand tools command 80 percent of the Japanese market even though five Japanese firms have lower prices.

Commitments to Quality

The enhanced concern with improving quality in American industry has not been primarily a matter of setting up new quality control departments or even expanding existing ones. After all, companies in the United States traditionally devoted far more resources to quality-control efforts than did their foreign counterparts.

But quality assurance is more than just a collection of expensive scientific and professional personnel checking, reviewing and improving production practices. Producing quality requires emphasizing this aspect of the production process throughout the firm.

The air-conditioner-industry study cited earlier confirms this point. Japanese companies pay more attention to quality than many of their American competitors by means of such innovations as creating internal consumer review boards to evaluate the products. Another way the Japanese foster quality is by having top management hold daily review meetings about quality. In contrast, American firms with the lowest assembly defect rates met 10 times a month; the worst-quality U.S. companies averaged four such meetings a month.

Management's message was reflected on the front lines of production. First-line supervisors at four of six Japanese air conditioner manufacturers surveyed said quality was most important to management; their counterparts at nine of 11 U.S. companies surveyed said meeting the production schedule was the highest priority.

Management can communicate its emphasis on quality by paying attention even to small details. For instance, National Steel now requires workers to clean their work stations instead of leaving the task for janitors. The Japanese co-owners, who suggested the policy, reasoned that if workers have enough pride to take care of their work stations, they might also care more for their product.

But there is more to improving quality than just providing an example. For instance, Chaparral Steel Company uses an unusual but no longer novel

approach to employee relations to ensure that workers put into practice what the company preaches: It practices egalitarianism in many aspects of its activities in an effort to improve output and quality. "We consider everyone to be line, there are no staff positions per se," says Chaparral President Gordon Forward. The company has no customer service representatives, for example. Production managers answer customer complaints. Forward says, "You ought to see how motivated they are to fix the problem when they come back."

The most effective quality controls involve a shift in the locus of responsibility—from inspectors to the employees who actually do the work.

Thus, the most effective quality controls involve, in effect, a shift in the locus of responsibility—from the inspectors in the quality control department to the employees who actually do the work. Pushed by foreign competition and the non-linear nature of America's free-market economy, many U.S. companies are discovering this way to achieve higher-quality production.

The Accelerating Growth of Research and Development

Even though many government officials occasionally wax eloquent about the science policy of the federal government, the United States lacks a comprehensive policy on the subject. Others can debate whether that is good or bad. What is relevant to this analysis is that the great bulk of research and development financed and sponsored by the federal government is not a result of deliberate actions to carry out a policy on "science." Rather, in most instances, it is more a matter of happenstance. Yet a shift in science funding has powerful effects on the competitiveness of American industry.

Thus, in the haphazard nature of science policy, the completion of the "man on the moon" project by NASA meant a reduction in that agency's budget. It just so happens that NASA devotes one of the highest percentages of expenditures to R & D among federal agencies. As shown in Table 4, NASA spent one-half of its budget on R & D in 1981, while the ratio for the federal government as a whole was less than 5 percent. Thus, a shift in emphasis in the federal budget away from space exploration was simultaneously a move to downgrade the importance of science in the federal government.

Similarly, and of greater consequence because of its overwhelming size, the post-Vietnam cutbacks in the military budget meant a major decline in the volume of federal R & D funding—but not as a deliberate policy. The shift in emphasis in the federal budget during the 1970s from, so to speak, warfare to welfare meant a shift of resources away from the most R & D-intensive sectors of the budget. Simultaneously, a rapid expansion occurred in federal spending

Table 4

FEDERAL AGENCY R & D AND TOTAL OUTLAYS IN 1984

Department or Agency	R & D Outlays (in billions)	Total Outlays (in billions)	R & D/ Total (percent)
Above-average R & D Ratios			
National Science Foundation	$ 1.1	$ 1.2	91.7%
NASA	3.5	7.0	50.0
Energy Department	4.7	10.6	44.3
Nuclear Regulatory Commission	.2	.5	40.0
Commerce Department	.3	1.9	15.8
Defense Department	23.6	220.8	10.7
Foreign aid (non-military)	.1	1.1	9.1
Interior Department	.4	4.9	8.2
Environmental Protection Agency	.3	4.1	7.3
Total, Federal Government	40.5	851.8	4.8
Below-average R & D Ratios			
Agriculture Department	.9	37.5	2.4
Health and Human Services Department	4.5	292.3	1.5
Transportation Department	.3	23.9	1.3
Veterans Administration	.2	25.6	0.8
All other	.4	220.4	0.2

Source: Compiled from data prepared by U.S. Office of Management and Budget.

programs that involve the least amount of outlays for science and technology, notably the Department of Health and Human Services (in the form of transfer payments) and the Department of Agriculture (primarily price-support subsidies).

The Recent Rise in Federal Funding

However, the massive buildup in U.S. defense spending begun in 1981 has ended the slowdown of federal R & D outlays that occurred in the 1970s. Now the largest dollar increases in federal expenditures are budgeted for the Pentagon, a part of the government that spends more than twice the proportion of its

budget on R & D than the typical civilian agency. To be sure, there is considerable controversy about the extent to which R & D spending by the military establishment benefits the civilian economy. Certainly not all military R & D has commercial applications. In fact, America has considerable negative experience with past attempts to apply defense technology directly to civilian uses.

A recent analysis of approximately 1,000 large U.S. manufacturing firms concluded that company-financed spending on R & D is more productive than federally-financed research. Presumably, the firm spends money on R & D to raise its productivity and profits, while government-financed R & D is undertaken primarily to fulfill specific research contracts for which the firm is remunerated directly.

It does seem, however, that subcontractors and supplying firms in the electronics and instruments industries, for example, have enjoyed considerable success in commercializing their defense-financed technology. In contrast, the large aerospace firms have demonstrated only limited ability to diversify outside of aviation.

All in all, when the Department of Defense devotes an additional $100 billion to applications of science and engineering in a half decade, there is a great possibility that a larger stream of product and process innovation will occur in the years ahead. That possibility is reinforced by the Pentagon's current tendency to support technological advancement in areas having civilian applications such as computers.

For example, the Department of Defense recently awarded Carnegie-Mellon University a $103 million contract to develop and operate a Software Engineering Institute. The bulk of the Institute's work will be original, unclassified research, including development of better education processes for teaching software. Although its main customers will be defense contractors, a second tier will include companies that build such commercial items as telecommunications and air traffic control systems.

Moreover, some analysts contend that the Pentagon's Strategic Defense Initiative (popularly known as "Star Wars") will yield commercial applications in such areas as supercomputers, software, sophisticated sensors and space technology.

High-yield supercomputers are useful in a wide range of scientific and industrial applications, including telecommunications, weather forecasting, medical research and aircraft design. The need to automate SDI systems is also expected to advance commercial applications in the emerging field of artificial intelligence. Likewise, in order to meet the tracking requirements of SDI, developments will take place in optical design and manufacturing that can have important civilian uses.

There is no need to jump to the conclusion that the most effective way of promoting scientific progress in the United States is to encourage a military buildup. Surely, the direct expenditure of these funds on civilian-oriented R & D, especially of a commercial orientation, would be expected to be far more productive. But the fact remains that the only time when Congress will appro-

priate tens of billions of dollars on R & D in a half decade is when it elevates national defense and such other R & D-intensive functions of government as space exploration and energy development to the top of the priority list. In 1984, for example, the Department of Defense spent $23.6 billion for R & D, the Department of Energy $4.7 billion and NASA $3.5 billion.

The only time when Congress will appropriate tens of billions of dollars on R & D in a half decade is when it elevates national defense, space exploration and energy development to the top of the priority list.

In striking contrast, when Congress decides to be generous to science and technology per se, it expands the budgets of the major science agencies by only tens of *millions* or, at best, by several hundred million dollars. In 1984, the total budget of the National Science Foundation came to $1.2 billion. That year the Department of Commerce spent about $300 million on the Bureau of Standards and all of its other scientific activities. The Department of the Interior devoted approximately $400 million to the Coast and Geodetic Survey and other R & D bureaus.

Also, federal funding for R & D tends to fall when income transfer programs are elevated to higher priority in the budget. In the case of the Department of Health and Human Services, R & D expenditures in 1984 comprised 1.5 percent of its budget (mainly for the National Institutes of Health).

The Results of R & D

Of course, it is far easier to measure inputs than outputs in the areas of science and technology. That is, we can more readily quantify the resources going into the performance of research and development than the new or improved products or processes that result.

Nevertheless, several economists have attempted to estimate the overall rate of return from research and development performed in the United States in recent years. As shown in Table 5, the estimates of R & D payoffs range widely. The lower figures usually are limited to benefits to the company performing the R & D, while the higher estimates include uses by the customers of the company and other firms. Surely, we would expect individual analysts to differ in their calculations. What is reassuring is that virtually all of the measured returns to R & D are impressively high.

In addition, the tax reforms of 1981 included a new tax credit for incremental R & D, an incentive in addition to direct federal spending in this area. Preliminary evaluations show limited effects in terms of added private-sector R & D undertakings. However, the temporary nature of the tax credit is cited as an important limitation; the credit is scheduled to expire as of December 31, 1985. In its current consideration of tax reform legislation, the House of Representatives voted last December to extend the life of the tax credit, but not to make it a permanent feature of the Internal Revenue Code.

Table 5

ESTIMATED RETURNS TO R & D

Researcher	Rate of Return	Area Covered	Years Covered
Scherer	70-104%	Macroeconomy	1973-78
Terleckyj	29-78	Macroeconomy	1946-66
Fellner	31-55	Macroeconomy	1953-66
Nadiri	20	Manufacturing	1958-75
Griliches	17	Manufacturing	1957-65

Note: Variations within and between studies often depend on the scope of the report (e.g. whether they include benefits to customers of the company doing the R & D).

Source: See bibliography.

In any event, data published by the National Science Foundation show a rapid upturn in growth rates of both federal and private expenditures on R & D in recent years and thus an acceleration in total R & D spending in the United States (see Table 6). During the four-year period from 1980 to 1984, federal spending on R & D in real terms (adjusted for inflation) rose 12.2 percent a year. This was a significantly more rapid growth rate than the 9.4 percent average for the preceding four years. During the same periods, private-sector-financed R & D spending rose at a greater rate—14.2 percent a year since 1980 and 13.9 percent annually in the prior four years.

Some of the specific instances of recent state and local investments in R & D are noteworthy. Since 1983, Michigan has invested more than $50 million in small, new companies. Three other states—Ohio, Illinois and Indiana— have spent more than $250 million on programs for new, high-technology entrepreneurs. In addition, the 13 states of the Midwest Governors Conference each have contributed $250,000 to open the Midwest Technology Development Institute in Minneapolis.

There are already some promising indicators of the effects of the stepped up

Table 6

REAL OUTLAYS FOR R & D, 1975-1984
(dollars in billions)

Year	Federal Government	Percent Change	Private Industry	Percent Change	Total[1]	Percent Change
1975	$16.6	–	$14.5	–	$32.2	–
1976	18.9	13.9%	16.8	15.9%	37.1	15.2%
1977	20.5	8.5	18.6	10.7	40.5	9.2
1978	22.3	8.8	20.9	12.4	44.9	10.9
1979	24.7	10.8	24.0	14.8	50.6	12.7
1980	27.2	10.1	28.2	17.5	57.4	13.4
1981	30.8	13.2	32.8	16.3	65.8	14.6
1982	34.5	12.0	37.7	14.9	74.5	13.2
1983	38.2	10.7	42.7	13.3	83.3	11.8
1984	42.9	12.3	47.9	12.2	93.4	12.1

[1] Includes universities and other non-profit institutions.

Note: Actual data have been deflated by GNP price deflator, 1972=100.

Source: U.S. National Science Foundation.

investments in R & D. According to the Federal Reserve Bank of Chicago, more than 15,000 companies make high-technology equipment in the eight states bordering on the Great Lakes. At least 100 new companies specializing in biomedicine and computer software have located within 50 miles of the Mayo Clinic in Rochester, Minnesota. Based on historical experience, we can expect that recent investments in research and development will create some new product lines and perhaps even new industries with high growth potential.

This process of "creative destruction" described by Schumpeter implies that some industries will likely decline while others take their place. As pointed out by Sven Arndt of the American Enterprise Institute, domestic products that incorporate substantial amounts of research and development become competitive while more mature items are increasingly replaced by imports.

Thus, products with well-established design and production technology often can be manufactured more economically abroad by producers who acquire blueprints, technological know-how and even factories in world markets. Their quality control is frequently superior, and a large part of the production costs is relatively cheap factory labor. High-priced workers in the United States using technologies that are available to their lower-cost competitors find it increasingly difficult to compete.

Investments in research and development constitute an important way in which American industry can hold its own in the face of virulent foreign competition.

Hence, investments in research and development constitute an important way in which American industry can hold its own in the face of virulent foreign competition. Improving process technology or offering new and superior products is a far more positive—and essentially more effective—approach than seeking government protection.

In many industries, designing and marketing new and better goods makes the future bright for an advanced economy such as the United States. That is, this country frequently maintains its comparative advantage in R & D-intensive industries. Table 7 lists 14 examples of successful penetration by U.S. companies in Japanese markets. In most cases, product development and technological skills are listed by the Japanese as the keys to the sales penetration by American firms. Thus, increased application of the fruits of science and technology to American industry is an important reason for expecting that today's gloom-and-doom expectations will turn into tomorrow's non-linear economic recovery.

The Outlook for the 1990s

Highlights of the Report

Let us now sum up the key points we have made. Throughout America's economic history, feedback effects have helped to end both upswings and downturns. The United States is experiencing such a change during the current period of economic slowdown. The feedback effects are arising from such diverse factors as the deep recession of 1981-82, intense international competition and rapidly expanding defense spending.

The resulting new and positive forces are:

(1) Managerial and governmental actions that reduce the cost of producing goods and services in the United States.

Table 7

SOME U.S. SUCCESS STORIES IN JAPAN

Company	Product	Share of Japanese Market	Keys to Success (as seen by Japanese)
Consumer Goods (Imported)			
Eastman Kodak	film	20%	brand name; lack of early competition
Procter & Gamble	disposable diapers	50	new product; acquisition of Japanese company's sales network
Warner-Lambert	razors	70	new product; use of Japanese company's sales network
Consumer Goods (Local Production)			
Coca-Cola	soft drinks	60	active advertising; distinctive production and sales set-up (franchises)
Corning Glass	heat-resistant glassware	30	new product
Kimberly-Clark	tissue paper	20	use of business partner's distribution network; technological and product-development skills
Johnson & Johnson	bandages	31	new product; active advertising
S. C. Johnson & Son	floor wax	30	technological and product-development skills
Capital Goods (Imported)			
Boeing	jet airplanes	60	careful market research; strong after-sales service
IBM	computers	40	technological skills

Table 7 (cont.)

SOME U.S. SUCCESS STORIES IN JAPAN

Company	Product	Share of Japanese Market	Keys to Success (as seen by Japanese)
Capital Goods (Local Production)			
Caterpillar	bulldozers	43%	technological and product-development skills; strong after-sales services
Martin Marietta	concrete mixing agents	50	new products
Dow Corning	silicon resins	20	use of Japanese partner's distribution network; technological and product development skills
Xerox	copiers	20	technological and product-development skills; distinctive sales system (rentals)

Source: *Trading With Japan* (Tokyo: Keizai Koho Center, 1985).

(2) Enhanced personal responsibility for the quality of what Americans produce.
(3) More rapid domestic growth in research and development, the basic fuel for innovation and technical progress.

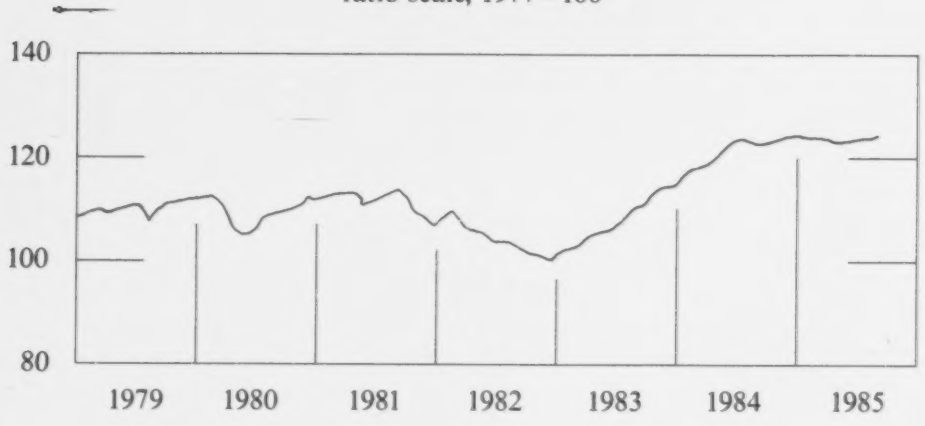
The often-painful changes provoked by greater competition, at home and abroad, range from out-sourcing to reducing labor costs to fundamental corporate restructuring. Simultaneously, many U.S. firms are discovering that product quality rests primarily with the workers on the front lines of production rather than in quality control departments. At the same time, the expansion of military spending has resulted in an upturn in federal research and development that has powerful spillover effects in the civilian economy.

None of these three factors yields quick or dramatic changes. Yet the cumulative and interactive effects that they generate are likely to endure and to reinforce each other. Virtually all of the changes work in the same direction—

Figure 3

INDUSTRIAL PRODUCTION, 1979-1985

ratio scale, 1977 = 100



Source: Federal Reserve System

toward generating new and better products that will result in more orders, production, employment, income and profits for American investors, managers and workers. These changes surely will not prevent the possibility of another recession during the second half of the 1980s. But they do make for a brighter outlook for the period beyond, that is, for the decade of the 1990s.

Thus, there is a reasonable basis for expecting that the ability of American firms to compete in world markets in the years ahead will be substantially improved. Likewise, the relative attractiveness of domestically produced products to American consumers should increase significantly. In the process, the real standard of living of the American people should rise noticeably.

In any event, we need to realize that the industrial sector of the American economy is far from being in the sad shape that many fear. In a journalistic version of Gresham's Law, it sometimes seems that bad news drives out good. It surely is not widely known that industrial production in the United States hit a new high in 1984 when the Federal Reserve's Index reached 122 (1977 = 100). During 1985, the Index of Industrial Production reached a plateau averaging 124 (see Figure 3). In fact, manufacturing's share of the real gross domestic production has held steady for the last 30 years—at about 25 percent (see Figure 4). Economic naysayers do not have a factual basis for their unalloyed pessimism. Manufacturing in the United States is not going "down the tube," nor are we becoming a nation whose major employers are hamburger stands and clothing stores.

Foreign Counteractions

On the other hand, the positive developments stressed in this report are not foregone conclusions. For one thing, foreign competitors can improve on their

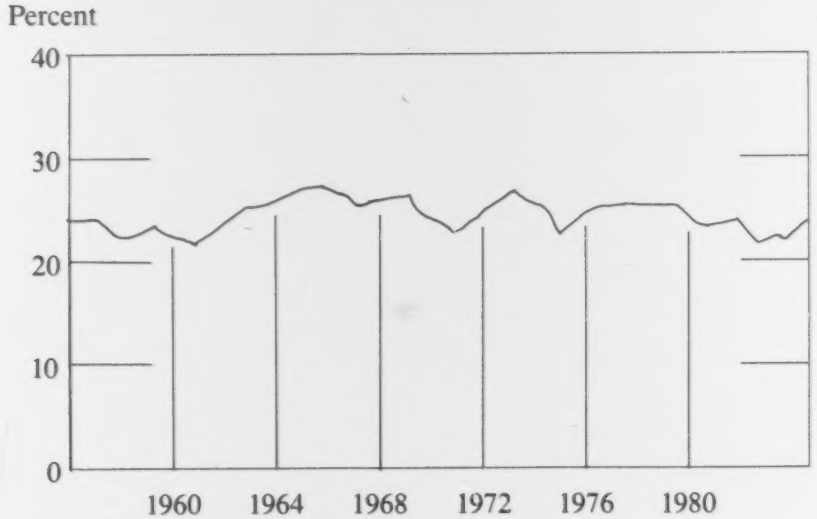
current strategies while U.S. companies try to catch up.

Signs of such a development are showing in the automobile industry. While a Wall Street Journal/NBC News poll in November 1985 reported that the percentage of Americans choosing to buy foreign-made cars had declined from 25 percent to 21 percent, it also found that one-third of college-educated Americans and 30 percent of Americans under 35 years of age said they would purchase a foreign car. Auto makers emphasize the importance of those groups: College-educated Americans tend to buy the most expensive cars and acquire them more frequently. And auto companies have also learned the hard way that if a young American's first car is foreign-made, it is harder to convince him or her to "buy American" in the future.

There is no certainty that America's Big Three car makers will succeed in closing the gap. Simultaneous with the improvements in U.S. automaking, Japanese motor vehicle manufacturers are becoming very different and more dangerous competitors. They are doing so by differentiating their products according to function, price and appearance as well as size, attacking the American Big Three from many directions at once. The Japanese have increased the 21 nameplates and 46 separate models made in 1980 to 34 nameplates and 74 separate models last year. "It won't be enough to have both fuel-efficient and high-quality cars," says Gerald Hirshberg, director of design at Nissan in California. "What's left is sheer creativity and agility that will dictate success and failure of new entries."

Figure 4

MANUFACTURING'S SHARE OF REAL GROSS DOMESTIC PRODUCT, 1956-1984



Source: Federal Reserve Bank of Cleveland

Nor are the Japanese the only competitors with whom American companies must deal. The South Koreans are pinning their hopes of opening U.S. markets to Korean brand products on the Excel, a subcompact car introduced in 1985. If the Excel is successful, it will add to the quieter successes of Korean-made products such as the Leading Edge D personal computer, which was the fastest-selling product in its industry during the last Christmas shopping season. In fact, Korean companies also have entered many U.S. consumer-goods markets such as color televisions as manufacturers for American brand distributors. "As the Japanese keep moving 'upmarket,'" says David Cole, Far East specialist at the Harvard Institute for International Development, "the Koreans can move in and take over."

Other countries also are improving their competitive positions and the changing relationships at times may be indicative of future trends. For example, Korean construction companies—who have increasingly been giving their American counterparts tough competition in bidding on overseas projects—are now complaining about the low-cost rivalry from Turkish and Indian firms.

Public Policies May Alter the Economic Course

Another factor that may hurt the chances of an improved economy in the 1990s is further public policy changes that may not all be benign. Pressures to reduce the budget deficit, for example, may result in raising the tax burden on saving and investment, reducing these basic factors for economic growth. Indeed, the tax reform bill that the House of Representatives passed in December 1985 eliminates the investment tax credit, reduces the R & D credit, and tightens up on depreciation allowances.

Also, should protectionist pressures succeed in leading to the erection of additional trade barriers, much of the resultant burden would be born in the form of higher costs imposed on the industries using higher-priced protected inputs. U.S. export industries would be especially hard hit—and would be vulnerable to retaliation.

In addition, a new round of burdensome domestic government regulation would both raise the cost of compliance and deter companies from investment and innovation. Moreover, another shift in federal budget priorities—from defense to transfer payments—could dampen the upward trend of R & D spending. Yet the three key forces for enhanced competitiveness identified here appear to have considerable momentum, and the prospects for their durability are quite bright.

Our upbeat conclusion is more than merely taking an optimistic position for the future. It relies on the powerful importance of feedback effects. The 1990s look good because downward trends tend, after awhile, to be reversed in the nonlinear American economy. But that phenomenon also alerts us to another, related fact that likely will be more germaine for the decade that follows: Upward trends breed a complacency that erodes the progress made during the doldrums. That underscores a far more basic point—in change there is both opportunity and challenge.

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